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Design, Construction, Maintenance and Traffic Control

H. P. GILLETTE, *Editor*

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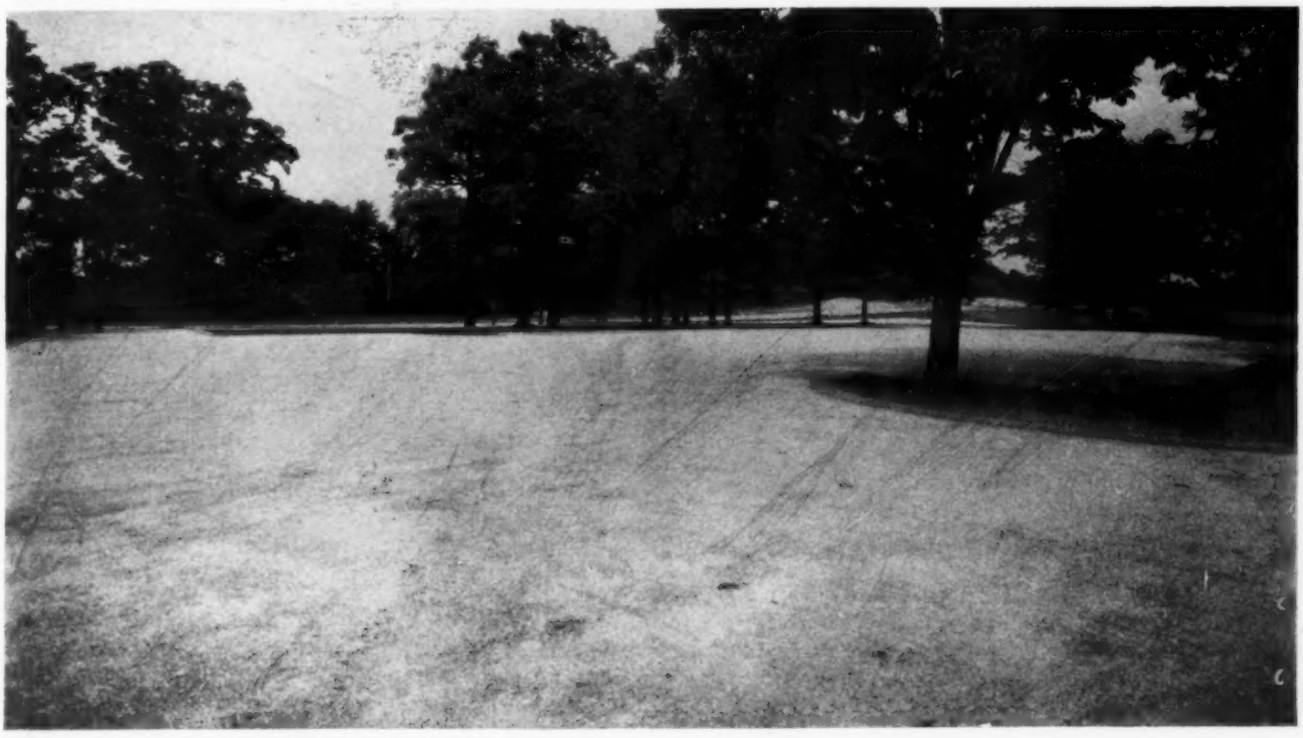


Parking Space at Northwestern Golf Course

Construction of Parking Spaces and Drives in Forest Preserves

By CHARLES C. ESTES

Chief Construction Engineer, Forest Preserves, Cook County, Illinois

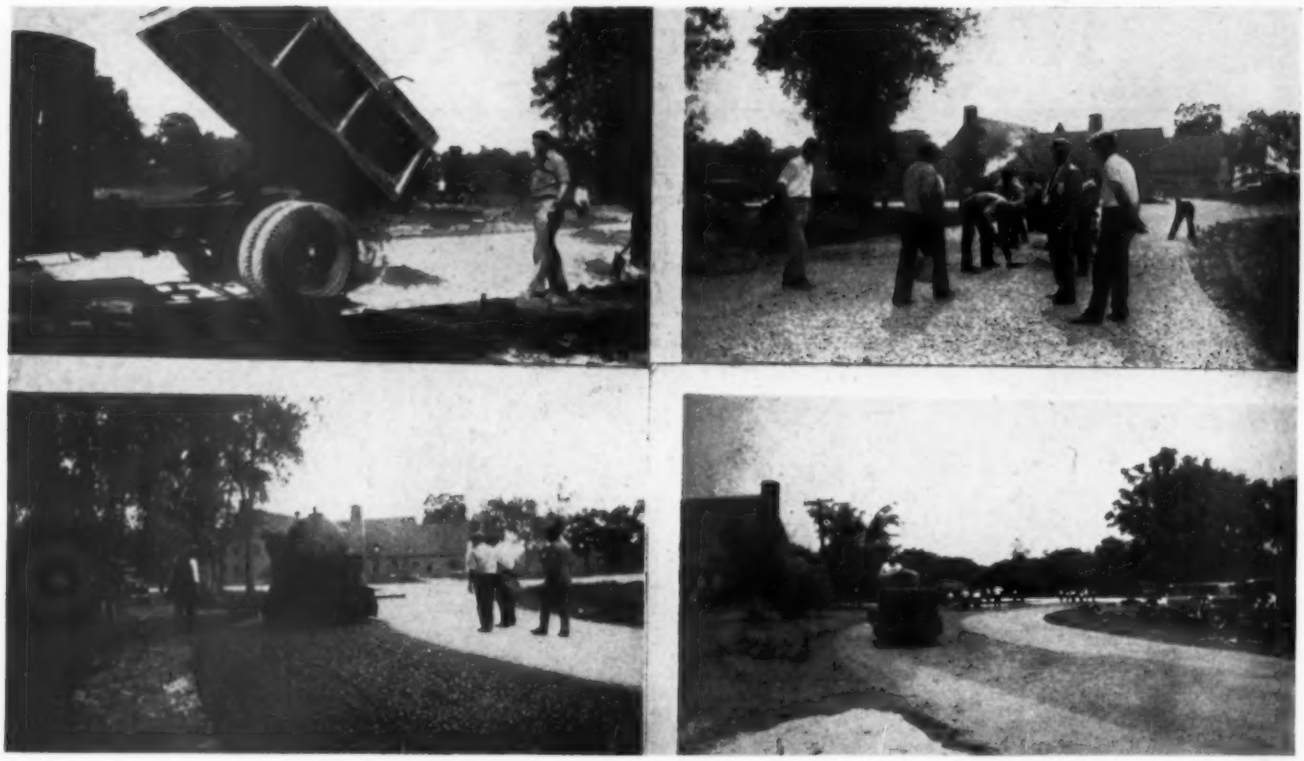
DURING the years 1930 and 1931 the development program of the Cook County Forest Preserve District included the construction of a number of parking spaces and drives in areas of concentrated use. One of the main problems in large tracts of forests is the control of automobiles. Due to the close proximity of 4,000,000 people of Chicago and Cook County to the 35,000 acres of Forest Preserves, the control of automobile traffic and parking has necessarily been recognized both from the standpoint of the automobile owner as well as forest preservation.

Foremost in the selection of a type of surface for parking spaces and drives was the initial cost followed by a consideration of the aesthetic value from a landscape viewpoint, low maintenance cost, and permanency.

The type of surfacing accepted as meeting all the requirements for the purpose of use consisted of a penetration macadam pavement finished off in native colored bird's eye washed pea gravel or coarse torpedo sand. The additional materials consisted of graded crushed limestone and petroleum asphalt emulsion.

Design Features.—The use of petroleum asphalt emulsion as a binder proved highly satisfactory giving excellent results. Four and one-half inches and 6½ in. of loose crushed limestone was used for parking spaces and drives respectively. The problem was to use a fine gradation that would compact under rolling and approach a dense solid mass as near as possible and at the same time have enough voids for the binder to flow down through and cement or glue the stones together.

The theory of the design was based upon the fact that with a bituminous binder evenly distributed throughout the mass of aggregate with the surface properly sealed, a desirable surface would be obtained. Using petroleum asphalt emulsion, manufactured from an asphalt with qualities of high penetration and ductility and having other rigid specified characteristics, the construction of this type of surface has been accomplished at a desirable low cost.



Upper Left: Tail Gateing Stone from Truck Prior to Leveling by Hand; Stone Layer No. 2 Over Screenings. Upper Right: Leveling Stone Layer No. 5; Extreme Care Was Taken to Obtain a True Crowned Surface. Lower Left: Emulsion Application No. 1; Note Complete Penetration Down Through the Tightly Compacted Aggregate. Lower Right: Rolling Torpedo Sand Finished Surface; Roller Progressing from Edges Toward Center

How Drainage Was Handled.—In the development of parking spaces to accommodate 300 to 1,000 automobiles, extreme care was necessary in the method of handling surface and sub-soil drainage. From an accurate set of field level notes the designer laid out the finished surface grades to fit the natural ground as close as possible and to insure a quick run off of storm water. The storm water collected at surface inlets and carried away through a network of sub-soil drains, all of which are an integral part of a parking space or drive development.

The secret of success during the course of construction depended upon rigid inspection and the ability of the contractor to grasp the feeling of refinement and care in the execution of the terms of the specifications.

Subgrade Preparation.—After the rough excavation was completed the subgrade was brought to a smooth,

A 300-Car Parking Space in Thatcher Wood

Parking Space and Drive with Second Application of Emulsion and Fine Stone Covering, Prior to Removal of Forms and Completion of Earth Shoulder

uniform, thoroughly compacted surface, true to line and grade, 4 in. in the case of parking spaces and 6 in. in the case of driveways below the elevation of the finished surface.

Along the edges prior to the construction of the paved surfaces, were constructed temporary wood forms to assist in obtaining the true, established grade and to maintain an accurate alignment of the edges. Prior to the third application of petroleum asphalt emulsion, the forms were removed and the space so created, was filled with dry loose earth thoroughly tamped in place.

To assist in obtaining and maintaining the required thickness and true grade of the pavement in a parking space area, temporary forms were provided and constructed in such a manner as to divide the area into lanes of a maximum width of twenty-four feet paralleling the direction of the slope of the finished surface. These forms were removed after the surfacing material was spread and properly leveled off between the forms of the lane. The contractor was allowed to set as many rows of forms as was practicable according to the size of the area until the entire parking space was so formed and covered with paving material and the surface made homogeneous.

After the preparation of the subgrade with the proper compaction by rolling, it was covered with limestone dust screenings. The layer of screening between the subgrade and loose stone was for two purposes. When using petroleum asphalt emulsion the screenings layer serves to keep the emulsion within the layer of loose stone and at the same time serve as a binder for the bottom of the stone section.

Cars Parking Immediately After Final Rolling of Torpedo Sand Covering of Emulsion Application No. 4

Pavement Built Up in Layers of Different Gradations of Stone.—Loose limestone was spread over the screenings in successive layers in different thicknesses according to the gradation for each layer. In developing the total thickness of a pavement by building up in layers of different gradations of aggregate, the voids of the finished thickness were reduced to a minimum with only ½ in. of compaction under 5 to 10-ton rolling. This method of construction was based on the theory, that with a low percentage of voids with a petroleum asphalt emulsion of high penetration and ductility, a paving layer could be developed which would approach a solid. The high penetration quality of the asphalt insured against brittleness in cold weather and the high ductility quality insured against bleeding, picking up and rolling in extreme hot weather.

The gradation of limestone aggregate, amount, applications of petroleum asphalt emulsion, the amount and kind of covering following each application and the operations performed between each application were as indicated by the accompanying table.

When stone was transported and dumped directly on the subgrade, the vehicles used were trucks equipped with not less than six wheels per truck, with four wheels on the rear axle, all equipped with pneumatic tires.

TABLE OF MATERIAL QUANTITIES FOR PARKING SPACES

Grading of Aggregate

Layer No.	Material	Gradation	Amt. per Sq. Yd.
1	Limestone screenings	Dust	100 lb.
2	Limestone	1 in.	104 lb.
3	Limestone	1¼ in. to 2 in.	139 lb.
4	Limestone	1 in.	70 lb.
5 (Chink'g)	Limestone	¾ in.	40 lb.

Bituminous Material, Etc.

Application No.	Amount of P. A. Emul. per Sq. Yd.	Amt. of Covering per Sq. Yd.	Kind of Covering	Gradation
1	1 U. S. gal.	30 lb.	Stone	¾ in.
2	¾ U. S. gal.	20 lb.	Stone	¼ in. to ½ in.
3	½ U. S. gal.	20 lb.	Washed pea gravel	Bird's eye
	Open to Traffic for 30 Days. Sweep Clean and Wash with Water Under Pressure			
4	1/3 U. S. gal.	10 lb.	Washed pea gravel	Bird's eye
		15 lb.	Torpedo sand	Coarse

TABLE OF MATERIAL QUANTITIES FOR DRIVEWAYS

Grading of Aggregate

Layer No.	Material	Gradation	Amt. per Sq. Yd.
1	Limestone screenings	Dust	100 lb.
2	Limestone	1¼ in. to 2 in.	104 lb.
3	Limestone	2½ in to 3 in.	208 lb.
4	Limestone	1¼ in. to 2 in.	70 lb.
5	Limestone	1 in.	70 lb.
6 (Chink'g)	Limestone	¾ in.	40 lb.

Bituminous Treatment, Etc.

Application No.	Amount of P. A. Emul. per Sq. Yd.	Amt. of Covering per Sq. Yd.	Kind of Covering	Gradation
1	1¼ U. S. gal.	30 lb.	Stone	¾ in.
2	1 U. S. gal.	20 lb.	Stone	¼ in. to ½ in.
3	½ U. S. gal.	20 lb.	Washed pea gravel	Bird's eye
	Open to Traffic for 30 Days. Sweep Clean and Wash with Water Under Pressure			
4	1/3 U. S. gal.	10 lb.	Washed pea gravel	Bird's eye
		15 lb.	Torpedo sand	Coarse

This insured against rutting and caused a uniform compaction of the surface driven over.

All layers of loose stone as shown in the table were spread by hand and shaped to conform to the shape of the finished surface. After spreading the total layers for a particular surface, the surface was sprinkled and rolled with a power driven tandem roller weighing 5 tons. After the necessary compaction, the surface of the area being paved was straight edged by means of a 10-ft. straight-edge. Immediately following the straight edging the surface was covered with a chinking layer of stone, rerolled and the bituminous treatments applied.

Before applying petroleum asphalt emulsion to any layer of stone, the stone was sprinkled sufficiently to clean the dust off each particle and to create a condition for more free flowing down of the asphalt when applied.

The bituminous material was always covered within five minutes after application and immediately rolled, thereby insuring perfect binding of the covering material before the bituminous material stiffened or set.

Costs.—The average cost of a number of parking spaces of 4 in. finished depth was $1.15 per square yard as compared to an average cost of $1.45 per square yard for driveways of 6 in. finished depth. Driveways were constructed with a thicker section due to carrying heavier traffic including some trucking.

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Alloy Steels in Road Building Equipment

By H. J. Deal
Metallurgist

The determining factors in the selection of an alloy steel to meet the requirements in road building equipment of an anti-friction bearing, and other tools, are: resistance to abrasive wear, strength, and ductility. These must be obtained as economically as possible, without undue sacrifice in machinability, or in the subsequent heat treating and grinding operations.

Several analyses are used depending somewhat on the bearing design and application and work which the road tool is designed to do. The ball bearing manufacturers have long recognized the necessity of a full hardened alloy steel such as high carbon—high chrome (S. A. E. 52100) as being the most satisfactory for their product. It is evident that any steel possessing the properties to satisfy the requirements of a ball bearing, where the loads are carried on a point contact, offers quite a large factor of safety when applied to a roller bearing where the loads are distributed over a line contact. For this reason, it was possible in the manufacture of roller bearings, to lower costs by substituting a carburizing analysis for the high carbon chrome and also obtain better machinability with less hardening problems.

Various carburizing grades have been successfully used but none so widely accepted as (S. A. E. 4615) Nickel Molybdenum, of the following analysis range:

Carbon .10-.20.
Manganese .30-.50.
Sulphur .045 Max.
Phosphorus .040 Max.
Nickel 1.50-2.00.
Molybdenum .20-.30.

It is of interest to note the occurrence, individual characteristics, and the effect of these alloying elements when added to a straight .10-.20 carbon steel.

Nickel is a white malleable metal harder and stronger than iron, and is produced in commercial quantities chiefly from Canadian ores. It is supplied to the steel maker in the form of shot or ingots of about 90 per cent purity.

Iron and nickel are soluble in all proportions in the molten state and remain as a solid solution on solidification.

Nickel increases the strength, yield, and hardness of steel without a corresponding loss of ductility. It permits a lower quenching temperature by depressing the critical or transformation points at which hardening takes place. It follows that with the lower temperatures less distortion will be encountered on quenching intricate shapes.

Molybdenum is a white soft ductile metal resembling platinum. The principal ore is its sulphide known as molybdenite and although it is widely distributed in many countries, the largest deposits are in the United States.

It may be added to steel as ferromolybdenum, calcium—molybdate or calcium—molybdenum—silicate, depending on the type of furnace and practice. It is soluble in iron similar to nickel, but also produces complex carbides and induces in the steel a marked ability to retain these carbides in solid solution upon cooling from hardening temperatures, thereby increasing strength, wear resistance, hardness and toughness. It is most effective when used with another alloy such as chromium, or nickel, or both.

The combination of 1.50-2.00 nickel with .20-.30 molybdenum results in an analysis capable of developing strength, hardness and ductility with high resistance to abrasive wear. It offers excellent machinability, as compared with any steel of equal alloying content, in fact, machinability alone favors its use for certain applications. Heat treatment, after carburizing, develops full file hardness on oil quenching without soft spots or skin softness common to certain carburizing analyses. Distortion is reduced to a minimum through low hardening temperatures and oil as a quenching medium. The high carbon case is well bonded to the low carbon core by the characteristic moly structure which aids in eliminating case spalling or exfoliation.

Wide acceptance, based on actual performance, in normal applications has proven the ability of this analysis to meet the requirements of a tapered roller bearing and other applications in tools in the highway and contracting industries. Where conditions are encountered; such as, corrosion, temperature, or extreme overloads, and costs are not a determining factor, other analyses such as high carbon chrome, Krupp and stainless steel deserve consideration for specific applications.

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Holland to Spend $175,000,000 for Roads.—Plans to spend $175,000,000 in 25 years on a road building program, covering more than 250 miles, have been completed, the ministry of public works of Holland announced. Roads between Amsterdam, Rotterdam, The Hague, and capitals of the Dutch provinces will be first built. One of the costliest projects will be the building of roads through reclaimed parts of Zuyder Zee, on dikes connecting Amsterdam with Gruningen.

Financing Street and Highway Improvements

By R. W. Crum

Member, American Society of Civil Engineers;
Director, Highway Research Board, National Research Council

THE Symposium on "Equitable Distribution for Highway Purposes of Motor Vehicle Licenses and Gasoline Taxes," conducted by the Highway Division of the American Society of Civil Engineers during 1929, brought out the status of contemporary practice and opinion representative of the various governmental jurisdictions interested. The papers and discussions presented in this symposium disclosed the fact that engineers in general concur in three basic principles.

In this paper the writer discusses from an engineering point of view, and without prejudice, some of the factors that appear to have a controlling effect in the equitable assessment of highway costs, and calls attention to some research projects that could aid materially in ascertaining the facts that are needed. These facts themselves will vary from place to place and from state to state, but the same methods of attack upon the problem should result in some uniformity in procedure.

Important Basic Principles.—In the separate papers presented by O. E. Carr, George B. Sowers, George H. Henderson, and Frederic E. Everett, Members, Am. Soc. C. E., and in the discussions elicited from all parts of the United States on this subject, there is evidence of concurrence in the following principles:

1.—Motor vehicle users should pay a fee to cover what is called, in public utility parlance, "readiness to serve." This may be considered to represent the motorist's contribution to the capital investment, and is generally collected through license fees.

2.—Motor vehicle users should also pay some amount based upon their use of the roads. This amount may represent their share of the operating costs of the highways, and is universally collected at the present time through imposts on gasoline.

3.—No part of the funds raised by means of motor vehicle license fees or gasoline taxes should be diverted to any other use than the construction, maintenance, and control of highways.

These three principles, and especially the last, are of great importance. It will be noted that they do not touch upon the controversial question of the allocation of funds among the various classes of roads and streets, or governmental units. With respect to this question many well-considered opinions were presented by authors and discussers. In general, the engineers reasoned from their own experience with one or more phases of road or street work, although they recognized that the equities of the situation have not yet been defined.

Some emphasized the point that engineers should consider all the facts and should not favor any particular interest—the small town, the city, or the state highway department. This is obvious, and there is no doubt that if engineers could study the facts underlying the problem they could recommend an equitable procedure. The difficulty at present is that all the facts are not available for study.

Determining the Road Users' Share of Costs.—The real problem is not how the funds being raised at the present time should be distributed, but rather what share of the annual expenditures on the various classes of roads and streets should be borne by motor vehicle users.

In order to determine correct amounts, sources, and distribution of funds for the construction, maintenance, and administration of any group of roads or streets, certain questions must be answered. Among such questions are:

1.—What are the roadway costs?
- (*a*) Cost of building; and,
- (*b*) Annual cost for administration, maintenance, and periodic replacement or renewal.

2.—What part of the costs should be borne by each of the various interests benefited?
- (*a*) Federal government;
- (*b*) State government;
- (*c*) Local community;
- (*d*) Adjacent property; and,
- (*e*) The user.

Having the answers to these questions for all the various systems of roads and streets in a state, the grand total of what the users should pay, could be added up and assessed if it is within the "ability to pay." If the entire sum could not be assessed, consideration would have to be given to the allocation of the funds raised so that they would yield the greatest good to the greatest number.

The answers will vary widely, depending upon such factors as class, type, location of roads, and traffic. The classification of roads adopted by the American Association of State Highways Officials is adapted to discussion of these questions. This classification is: (1) Primary roads, comprising the federal and state systems; (2) Secondary roads, the principal county trunk highways, or state-aid highways; and (3) Third-class roads, the purely local township roads. To these should be added city and town streets.

Primary Roads.—Primary roads are the highways that provide for interstate, inter-city, and inter-county transportation which, it is generally agreed, should be built and maintained by the state with such aid as is contributed by the federal government. This system, as thus far defined, stops at city limits. However, the discussions in the symposium indicate that a considerable number believe that the extensions of these roads into and through the cities should be considered a part of the state primary system. In so far as engineers are concerned, there can be no doubt that, in planning for the movement of traffic over primary roads, the city links cannot be neglected, therefore, these streets will be considered in connection with the primary roads.

In any business undertaking, public or private, there must first be an outlay of capital. Then, if the enterprise is to be on a sound basis, it must earn enough to pay interest on the capital, to pay the operating and fixed charges, and to provide for anticipated renewals and replacements. In the case of a public project, such as a system of highways, the soundness of the enterprise can be assured if the governmental unit concerned levies

enough taxes upon the benefited parties to provide the necessary sum each year to cover the financing of the capital outlay and the annual cost.

The rate at which a system can be built will depend upon what the benefited interests can afford, and upon whether the payments for construction are to be made directly from the tax money or from borrowed money. The reasons why the issuance of bonds for road improvements under certain conditions is sound public policy have been ably presented[1] by T. R. Agg, M. Am. Soc. C. E., and John E. Brindley, Professor of Economics, Iowa State College, Ames, Iowa. The writer is principally interested in the determination of the total annual cost so that the necessary taxes can be levied.

Need for Co-Operation.—The building and operating of a highway system is a huge co-operative enterprise of the people of a state, for which they must first furnish the capital, and then must pay individually for the use of the facilities. Their profit comes in lowered vehicle operating costs and in other more or less intangible benefits.

At any given date, the money and time necessary to bring the entire system to the desired standard can be estimated. If the pay-as-you-go plan is followed, the tax levy for construction will naturally be whatever the benefited interests can afford each year; and if bonds are to be issued, the construction fund should be sufficient to pay them as they mature, as well as the accrued interest. By issuing serial bonds, these annual imposts can be made uniform over any number of years.

The determination of the amounts needed per year for operating expenses and for periodic renewals is more laborious, but there is no reason why they cannot be calculated on a sound basis for any highway system. This involves computation of the annual highway cost for those parts of the system that are already completed, and estimates of the probable annual cost of the remainder during and after the construction period.

Annual Roadway Costs.—The Committee on Transportation of the Highway Research Board, National Research Council, has proposed a method for computing the annual roadway costs as of the date when the data are assembled, for any specific section of highway.

The annual cost of a section of highway consists of the interest on the cost of construction, or value at the time of the analysis, plus the annual maintenance cost, including administration and engineering, plus the sum that must be set aside each year at compound interest to provide money for periodic renewal or replacement. This is expressed in a formula, as follows:

$$C = r\left(A + \frac{B}{r} + \frac{E}{(1+r)^{n}-1} + \frac{E'}{(1+r)^{n'}-1} + \ldots\right) \ldots . (1)$$

in which, C is average annual cost; A, the cost to construct; B, the yearly maintenance cost; E, the expenditure for periodic maintenance every n years; E' the expenditure for reconstruction every n' years; and r, the rate of interest prevailing in current financing.

An estimate of the total annual cost of a highway system would have to be built up piecemeal since the factors would vary on different roads. On those sections of the system included in the construction program, the annual cost would be calculated for the date on which the analysis was made, and then could be estimated for each year in advance, until the end of the construction period. The result of such calculations would be a tabulation showing the amounts that the system would actually cost the people of the state for capital investment and for annual cost.

If this annual cost should be collected through some form of taxes, the revenue would be in excess of the expenditures, at least to the extent of the interest factor. This excess would no doubt be needed for those changes and betterments in the system, that would appear from time to time.

Knowledge of Costs Helpful.—Although it might not be feasible, for administrative or legislative reasons, to assess the interest and carry a sinking fund as provided in these calculations of costs, a knowledge of the actual annual cost of providing the roads would be helpful in planning both revenue measures and expenditures. These costs, after deductions for Federal Aid, would be the amount that might be fairly assessed against the vehicle operators, if a state highway system were to be built and operated on money raised by license fees on motor vehicles and taxes on gasoline.

Anticipating the acquisition of fundamental data for use in this motor-vehicle tax-distribution problem, it would be a worth-while research project to have the annual highway costs computed for all or for part of a state highway system. This would be a laborious job, it is true, but how else can such basic data be secured?

Sources of Funds.—The parties that would be benefited by the completion of a state highway system are: (1) The United States; (2) the state; (3) the local communities; (4) real estate and (5) the road users.

The Federal Government recognizes the value to the Nation of roads that are needed for interstate transportation and national defense. Hence, Federal aid on the construction of these highways is well established and will probably continue for some time.

Since it is generally realized that the state is the principal beneficiary of the primary system of rural highways, it is a well-established principle that these roads should be built and maintained by the state organization, on money raised by the state. As the entire population is affected to some degree by the use of the main highways, it seems equitable to spread the cost over the population by means of taxes borne by motor vehicles, consisting in part of a service charge and in part of a payment proportionate to the amount of use. As far as can be determined, this arrangement appears to be acceptable to the users.

It is probable that the benefits to the local community and private property are relatively greater on extensions of primary roads into and through towns and cities than in the rural districts. Little information has been assembled to show the true relationship existing between community interests, private property, and road users. As a matter of fact, this relationship undoubtedly varies from place to place and from state to state, but a thorough study of even one case would be of immense value in pointing the way to a profitable solution in other places, and in establishing some principles of general application.

Factors needing study are: (*a*) The volume of through traffic, local traffic, and public carrier traffic; (*b*) the effect of through and local traffic upon the design of pavements; (*c*) the use of streets for parking, this being an extensive street use that cannot be measurd by a tax upon fuel; (*d*) the relation of the highway to local business; and (*e*) the effect of street improvement upon property values. Many data and painstaking analyses are required. If the interests of the various parties could be evaluated, it should not be difficult to secure a fair share of the cost from each.

[1] "Highway Administration and Finance."

Secondary Roads.—Secondary roads are the principal country trunk highways, mainly important to the immediate agricultural regions and market centers which they serve. An analysis of annual highway costs would also be valuable on roads of this class. Some of the states, recognizing that these roads are necessary to general prosperity, grant aid on important secondary projects; others take them over into the primary system when funds for extensions become available. As state money is ordinarily derived from user taxes, these methods can be adapted to take care of that portion of the total cost of secondary roads that should be borne by the road user.

As the communities served are the chief beneficiaries of the secondary roads, it is usual to finance them by general property taxes. Benefits to adjacent property by secondary road improvements depend upon such factors as the extent to which the entire region is served, the character of the traffic, and the character of the improvements. Although improvement is undoubtedly a benefit to farm land, it may not be of value beyond a certain degree of all-year usableness. When the residents along a particular stretch of road desire to expedite the improvement of it, financing by means of an assessment district may be advantageous. As many secondary roads have considerable transient traffic that is of no value to the local district, the only way to get a contribution from this traffic is through state taxes affecting the user.

Studies of land values, land income, and the amount, character, origin, and destination of traffic are needed to arrive at the proportion of secondary road costs that should be borne by the various interested parties.

Third-Class Roads.—Improvement of third-class roads, which exist primarily to give access to the farms of the country, constitutes one of the most pressing and difficult of highway problems. The principal beneficiary of these roads must be the farmer, because an outlet is essential to his success. However, the interest of the community in them can scarcely be less than his, because successful farms are necessary to its prosperity, and the general property tax touching both is probably fair.

In particular cases the improvement of certain roads by means of special assessment districts may be profitable to the land owners. Traffic is light and the relative share of the users, as such, in the costs is slight.

City Streets.—In the cities, beside the extensions of rural through routes, there are residential streets, business streets, and intra-city through routes. The residents are the greatest beneficiaries of improvements on strictly residential streets, and the practice of assessing the major part of the cost against the real estate benefited has become established as equitable.

The city at large and the users, especially public carriers, have considerable interest in business streets, which are also vitally necessary to the business houses using the adjacent property, so that their share of the cost is probably relatively large. The street railways pay for their share of the pavement and upkeep, while buses, taxicabs, and public carrier trucks have an interest that can be assessed by the city in various ways. It is true that many of these vehicles do not operate outside the city limits although they contribute through license fees and gasoline taxes, to the primary road system. It can be claimed in justification that the prosperity of the city is enhanced by the existence of a good system of tributary roads.

On business streets, the problem of who should pay for that portion used for parking space is perplexing. It is probable that the subject is of greatest interest to the vehicle users, although the city at large, or the adjacent property, may have to bear the burden. The value of street parking to business houses needs to be evaluated, and there is much evidence relative to this problem in the traffic data that have been collected in many of the larger cities.

The intra-city through highways may be a detriment to the abutting property although benefiting a zone of some width. The city at large and the public carriers have considerable interest in these streets, and it may be that the interests of the private users and the city coincide. Study of the available data, to evaluate these factors in terms of benefits to the various parties concerned, is needed as well as a study of property values and the earning capacity of real estate in the zone benefited by these streets.

Needed Research.—This symposium has brought out the need for factual studies before sound conclusions can be reached as to the relative parts of the cost of each road or street system that should be paid by the state, the community, the adjacent property, and the users. Although it does not appear probable that the relationships can be reduced to formulas, an engineer finds such studies essential to the exercise of judgment.

Four needed research projects may be mentioned:

1.—Calculation of the annual cost of all or part of a state highway system. It is expected that the Committee on Transportation of the Highway Research Board will continue its work in this field.

2.—A study of the amount, character, origin, destination, and purpose of traffic on city streets that are extensions of the state primary road system.

3.—A study of real estate values and earning capacity in the vicinity of through streets in cities as affected by street improvements.

4.—A study of the effect of road improvements upon rural property values and earning power.

Conclusions.—As a result of this study, the following conclusions have been drawn:

1.—Motor vehicles should pay a "readiness-to-serve" charge.

2.—Motor vehicle users should pay for roads in proportion to the extent of their use.

3.—Funds raised through special taxes on motor vehicles or motor-vehicle users should be used only for highway improvement.

4.—It is not possible, from the information at hand, to determine what proportion of road costs should be paid from user taxes. General practice concedes that the major part of the primary road costs shall be paid from motor-vehicle license fees and taxes on gasoline.

5.—The state should be the sole agency levying special taxes upon the motor vehicle or highway user.

Acknowledgment.—This is abstracted from a paper presented at a meeting of the American Society of Civil Engineers.

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Recent Legal Decision

A seller of gravel and sand to a Minnesota county for surfacing and repairing one of its roads, under a contract which was void because not authorized or ratified by the county board, could recover in quasi contract an amount equal to the benefit received by the county.

Wakely v. County of St. Louis; Minn. Sup. Ct., No. 28404, Aug. 7, 1931.

City Entrance Designed as Part of Park Development

By E. F. RAWCLIFFE

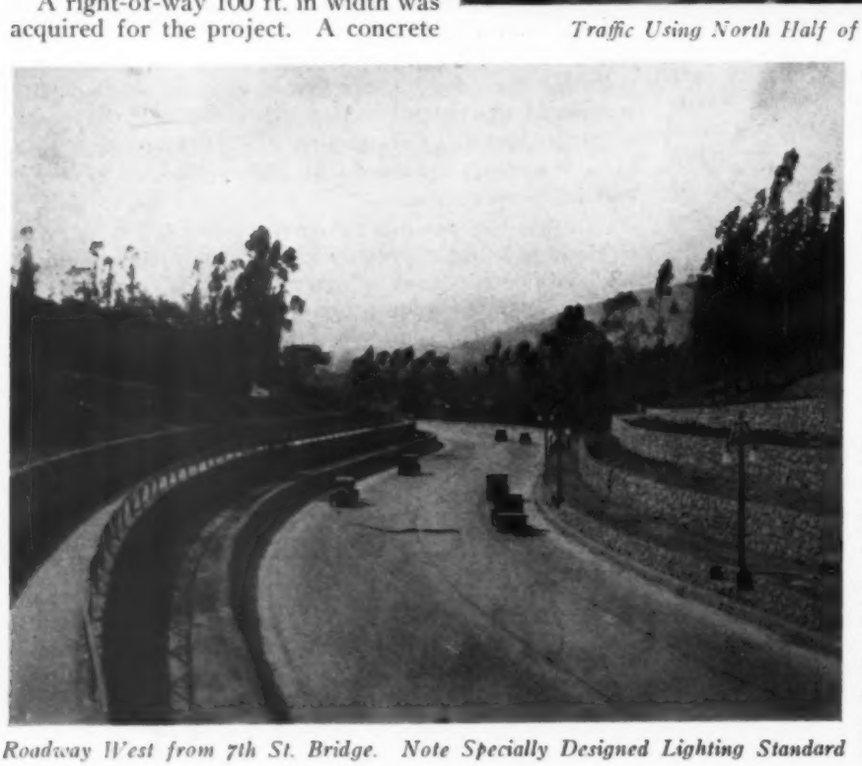
A NEW west gateway development at Riverside, Calif., designed to harmonize with the natural beauty of a hillside area is now open to motorists. The improvement includes a 4-lane concrete roadway, masonry retaining walls in terraces along a hillside, unique lighting standards with design protected by copyright taken out by the city, distinctive handrails at the edge of the sidewalk, and a grade separation bridge carrying cross traffic overhead.

The development extends for about ½ mile along Buena Vista Ave. from the state highway bridge over the Santa Ana River at the west city limits to West Seventh St. The roadway skirts the base of Mount Rubidoux, which has been taken over as a city park. Plans for the improvement were developed as part of the park landscaping scheme.

Frederick Law Olmstead, noted city planner, was a consultant on the project. The structural design and working plans were furnished by Davidson and Fulmer, civil engineers of Riverside, who also supervised construction. Mattich Bros., contractors of Elsinore, Calif., were awarded the contract for the entire improvement.

A right-of-way 100 ft. in width was acquired for the project. A concrete retaining wall ranging in height from 2 ft. to 22 ft. and containing about 12,000 cu. yd. of concrete was built along the north side at the lower end to hold the fill on which the roadway is built. The retaining wall is surmounted by a decorative balustrade made up of a series of precast concrete units having an unusual "rain-cross" design. This design is also used for the lighting standards along the new roadway.

Traffic Using North Half of Roadway During Construction



Roadway West from 7th St. Bridge. Note Specially Designed Lighting Standard

At the upper end of the avenue extending along the hillside for the length of the improvement, rubble masonry walls were built. These walls, which average 6 ft. in height, are built in terraces along the hillside. They are 18 in. in width on top and are made of stones of a size that could easily be handled by one man. A concrete sidewalk 5 ft. wide was laid on the second level of the hillside terrace. The walk is 4 in. thick and is marked off in a flagstone pattern. A 4-ft. handrail made up of 2-in. welded wrought iron pipe covered with cement plaster on metal lath is placed along the edge of the terrace between the walk and the roadway. Three coats of plaster were applied to the rail; instead of using trowels the workmen applied it with their hands which were protected with sections of automobile

Completed Project Showing 7th St. Bridge, Roadway, Terraces and Unique Hand Rails

inner tubes. The final plaster coat was combed to resemble the bark of trees.

The new roadway is 54 ft. wide, consisting of four 15½-ft. strips. At the Seventh St. end of the project an old rock-faced memorial bridge with a clearance of only 14 ft. spanned the old 20-ft. roadway. This bridge was demolished and a new one having a vertical clearance of 20 ft. and a span of 60 ft. was erected. The bridge is faced with light grey granite and carries a roadway of 20 ft., permitting traffic to cross on Seventh St. without interfering with vehicles entering or leaving the city.

Despite the fact that traffic averaging about 5,000 vehicles per day used the roadway continually during construction, the pavement was laid without much difficulty. Each of the four traffic lanes was laid singly to permit other parts of the roadway to be used by traffic. In certain instances it was necessary to have one-way traffic for a short time under flag control.

The cement-concrete pavement in each of the four lanes is 7 in. thick with edges of the sections flaring to 9 in. in the outer 3 ft. Expansion joints filled with ½-in. Elastite rubber joint material are placed at 35-ft. intervals. Expansion material is also used between the two center strips of the pavement, other longitudinal divisions being merely construction joints.

The pavement was machine finished, followed by three longitudinal floatings which produced an excellent riding surface. Each concrete slab was cured for 10 days with wet earth and was opened to traffic in 14 days. 28-day strengths of well over 5,000 lb. were indicated by test.

Excavation for the roadway required the removal of 62,000 cu. yds, 75 per cent of which was rock. This work was accomplished by drilling, blasting and shovel work.

An interesting feature of the project is the especially designed lighting standards which are copyrighted by the city of Riverside. Each standard carried a 60-lb. cast bronze bell in addition to two lighting fixtures and the "rain cross" design.

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Iron Roads

An experimental iron road surface has been laid down on a portion of the Romford-road at Stratford, and last Tuesday Mr. Frank Hough, chairman of Henlys, Ltd., drove the first car over the new stretch of road. The statement is made that it is very difficult to make a car skid on the new surface, while there is a noticeable reduction in noise when traffic passes over it. The road is constructed of cast iron blocks about 2 in. deep and shaped on their upper surfaces in a diamond pattern, similar to that found on Goodyear tires, from which, indeed, the design has been copied. The grooves in the pattern are about ¼ in. deep. The blocks are laid in bitumen and experiments carried out at the makers' works suggest that there is no tendency for them to become displaced. At present only about 60 ft. of road has been laid in this manner, but from this length it is hoped that sufficient experience will be gained to justify its use in other localities. Its life, at least, should be long, and the claim is made that, once laid, it would require very little attention.—*The Engineer (London).*

METHODS AND CHARGES
for Repairing Pavement Cuts

THE Bureau of Municipal Affairs of the Pennsylvania State Department of Internal Affairs has been collecting information on the methods and charges for repairing cuts on paved streets in cities of the third class in Pennsylvania. We are indebted to Francis J. Mulvihill, Chief, Division of City Planning and Municipal Engineering of the Bureau, for the information that follows.

Allentown—Ordinance requires permit. Brick, concrete, various tar and asphalt macadam done by city forces:

Charges:

Brick, per sq. yd. Plus cost of new brick.	$4.00
Concrete, per sq. yd.	6.00
Macadam, oil bound, per sq. yd.	2.00

Sheet asphalt, asphaltic concrete and other permanent black tops done by contract:

Bids: May 5, 1931, Awarded A	Unit Costs A	B
Concrete base, 6 in., 1700 sq. yd.	$1.55	$1.70
Concrete base, 8 in., 10 sq. yd.	2.00	2.10
Bituminous base, 3 in., 100 sq. yd.	1.25	1.50
Sheet asphalt pavement, 2½ in., 2300 sq. yd.	1.40	1.90
Sheet asphalt top surface, 1 in., 150 sq. yd.	.80	1.00
Sheet asphalt top surface, ¾ in. with paint coat, 100 sq. yd.	.75	.90
Binder mixture, 1000 tons	4.80	5.00
Binder, placing and rolling, 20,000 sq. yd.	.10	.06
Top surface, mix., 1400 tons	7.75	7.50
Top surface, mix., placing and rolling, 28,000 sq. yd.	.16	.15
Heater work, 8000 sq. yd.	.15	.15
Paint coat, 18,000 sq. yd.	.07	.05

Charge: Contract price plus 10 per cent.

Altoona—Permit required. Deposit (cash) computed by city engineer for area 1 ft. each side of trench.

Charge: 1-5 sq. yd., $40.00; 5-10 sq. yd., $80.00; over 10, per sq. yd., $8.00.

Surface replaced by city forces. If cost exceeds deposit applicant pays difference. If cost is less than deposit there is a refund.

Beaver Falls—Ordinance requires permit ($0.50) from city clerk and deposit (cash or certified check).

Charge: Paved streets, length of trench per ft., $1.00. Applicant makes cut, back fills and replaces surface. Inspected, after 60 days, by city engineer or street commissioner. If approved, certification is made to city clerk and deposit is returned to applicant.

Bethlehem—Ordinance requires permit (fee $1.00) and deposit:

First class paving, on concrete base for min. (36 in.), trench width, $5.00 per sq. yd.

(Ordinance allows charging an area 6 in. beyond area actually cut. $5.00 extra where trolley tracks are crossed.)

Bituminous, penetrated, with or without crushed stone base, $3.00 per sq. yd.

Bituminous, surface treated, $1.00 per sq. yd.

City replaces surface. If deposit exceeds actual cost there is a refund. If the cost exceeds deposit the applicant pays the difference.

Bradford—Permit required (from director of streets) and deposit, indemnity bond ($500.00). City forces replace surface.

Charge: Cost plus 10 per cent (rarely exceeds $6.00 per sq. yd.).

Require: Excavations, full length of trench; no tunneling, backfilling, no wet or unsuitable material; mechanical tamping; concrete slab base; present practice surface mix and curing and ready for traffic in 3 days against former 10 days.

During three years there were 5 failures out of 1000 openings where tunneling had been done or against curb where proper shoulder was not provided.

Butler—Ordinance requires permit, and agreement that applicant will pay the actual cost of refilling and repaving, to be done by the city, and deposit, with the city clerk, who issues permit. Deposit: minimum, $5.00.

Charge: Estimated length of trench 18 in. maximum width, per foot $2.00.

If cost is less than deposit balance is returned to applicant. If cost is more than deposit the applicant pays the difference.

Chester—Ordinance requires permit.

Charge: Based on unit prices for each class of paving in a yearly contract which shall be awarded by City Council. The minimum charge for any street opening shall not be less than $3.00.

Clairton—Ordinance requires permit. All backfilling and surface replacement done by city forces.

Deposit (cash or $2,000 bond) to city clerk based on city engineer's computations.

Deposit (minimum):	
Unpaved street	$10.00
Unpaved street surface, slag or ashes	25.00
All kinds of paving	50.00
Backfilling:	
Unpaved street, per cu. yd.	5.00
Paved street, per cu. yd.	6.00
Replacing surface:	
Brick, concrete, asphalt or other hard surface, per sq. yd.	6.00

Connelsville—Ordinance requires permit. Restoration by applicant except in concrete and bituminous surfaces, which are done by city forces, charged at cost.

Duquesne—Ordinance requires permit; issued by city engineer, after fee, $1.00. Deposit: $25.00 for certain area and additional for larger. Applicant makes temporary replacement until street commissioner makes permanent replacement. A refund is made if the cost is less than deposit.

Easton—Ordinance requires permit, issued by city engineer after fees paid to city treasurer, based on schedule, approved by city council and effective June 16, 1928:

	Per Sq. Ft.
Amiesite, on macadam base	$0.40
Amiesite, concrete base	.50
Brick	.55
Bituminous macadam	.40
Kyrock	.35
Belgian block	.50
Stone surfaced	.15
Unimproved	.05
Reinforced concrete	.55

Erie—Permit ($3.00) required; city engineer issues on authorization by city council, unless to public service corporation. Cuts repaired by city, charging costs to owner. Brick paving sometimes replaced by owner.

City charges:

Brick, including concrete base, per sq. yd.	$4.00-$5.00
Most pavement asphalt:	
Base: 30 in., per sq. yd.	1.75
More than 30 in., per sq. yd.	2.75
Binder and top, per sq. yd.	2.25

Measurement taken when repairs are made, includes area cut back from cut edge.

Franklin—Work of replacing pavement done by city force. Actual cost charged to applicant.

Greensburg—Repaired by city forces. Cost (labor and materials) billed to applicant. Public service corporations post bond ($1,000) and individuals deposit ($50) refunded when street is repaired.

Harrisburg—Permit required, bonded applicant, who has option to replace base or have city do it. Two years maintenance required of applicant.

Charges:	
Asphalt top and binder, per sq. yd.	$2.50
Concrete base, if by city, per sq. yd.	3.00

Owner usually replaces base through a contractor.

Hazelton—Work done by contract. Contractor furnished copy of yardage (city measurements), location and ownership of cut; sends out his own bills, verified by the city engineer:

Costs: Sept. 5, 1931	Per Sq. Yd.
Amiesite	$4.60
Brick	5.60
Concrete	3.50

Johnstown—Ordinance requires permit. Applicant furnishes bond and guarantees two years maintenance. Asphalt and bituminous pavements replacements made by city, charging actual costs. Other types of paving is done by applicant.

Lancaster—Cost of permits:

	3 or sq. yd.	Each additional sq. yd.
Sheet asphalt, concrete base	$20.00	$6.00
Vitrified block, concrete base	15.00	4.00
Vitrified block, gravel base	5.00	1.50
Amiesite, bituminous macadam of similar surfaces	10.00	4.50
Granite block, concrete base	15.00	4.00
Granite block, gravel base	5.00	1.50
Wood block or asphalt block	12.00	2.50
Macadam	5.00	1.50

Lock Haven—City places 8 in. concrete base and on it lays surface of brick. Separate costs are not kept per square yard.

McKeesport—For all types of paving:
Minimum charge (2 ft. by 10 ft.), $12.00.
Above this, charge is per running ft., $1.00.

Monessen—Permit required; deposit ($10.00); applicant replaces surface, subject to inspection of street commissioner; if passed, deposit is returned; if not, city replaces surface, deducting costs from deposit. Mostly brick pavements. Deposit may be raised to $25.00.

Oil City—Ordinance requires permit. Fee or bond (option).
Charges: Minimum total, $10.00.
Up to 50 sq. yd., $5.00 per sq. yd.
Over 50 sq. yd., $3.50 per sq. yd.
City replaces surface.

Reading—Ordinance requires permit, from bureau of permits and records. Held for 6 months, during which time city forces restore surfaces. Cost plus 10 per cent is billed applicant. If cost is less than deposit there is a refund. If cost is more than deposit applicant is billed the difference.

Deposit:	Per Sq. Yd.
Wood block paving	$10.00
Brick, asphalt, hot mix., granite block, concrete	8.00
Bituminous macadam	6.00
Waterbound macadam and misc. unimproved streets	4.00

Sharon—Permit required; plumbers and public service corporations furnish bond ($2,000). Applicants backfill and restore surface temporarily. In summer top fill with mill ashes and in winter lay plank flush with pavement. City forces make permanent replacement, charging actual costs plus 15 per cent.

Uniontown—Permit required, from city engineer. Deposit (bond), one year maintenance. City reserves right to make replacement in the event of failure when made by applicant. Charges: Cost plus 15 per cent.

Washington—Ordinance requires permit. Applicant agrees to pay city actual cost of backfilling and surface restoration plus 15 per cent.

Wilkes-Barre—Ordinance requires permit and fees:
Asphalt block or sheet asphalt, $4.00 per sq. yd.
Brick and other types, $3.50 per sq. yd.

Williamsport—Ordinance requires permit. Deposit is equal to twice the estimated cost of replacement by the city or a bond ($1,000) received by the city engineer, who issues permit. Highway department replaces surface, charging costs to the applicant.

York—Ordinance requires permit ($1.00) and bond ($500.00).

Charges:	Per Sq. Yd.
Brick, grouted in cement on 6-in. concrete base	$ 7.45
Brick or wood block, grouted with sand or pitch	5.25
Sheet asphalt, 6 in. concrete base	12.00
Reinforced concrete	8.65
Cobblestone, brick, gutters, etc., on earth base	2.10
Macadam	.50

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Courtesy on Roads

A decision in Muskegon that is of interest here was handed down by Judge Vanderwerp in a damage suit growing out of an automobile collision.

In this particular case the driver who sought to recover damages had the right of way, but the judge held that he could have stopped and avoided the accident and that therefore he could not recover damages.

The fact that, although he had the right of way according to the rules of the road, he could have stopped and avoided an accident but did not, undoubtedly was contributory negligence as the judge viewed it.

When two cars approach an intersection of roads there must be some method of determining which has the right of way. Ignorance of this rule often puts a driver into a wrong position. In this case, it is obvious that by waiving his rights and stopping the one who has the right of way can avoid many of the accidents that now happen.

No driver on the highways is unfamiliar with the bully at the wheel who in such circumstances will make his bluff to see if the other driver will not give way. They are a menace to all careful drivers. But, in general, if a little more courtesy was extended at highway intersections, regardless of the right of way, accidents would be lessened and damage suits such as that at Muskegon infrequent. Just a little of the courtesy that is shown in the home in passing from one room to another would work wonders at highway intersections. —Pontiac Daily Press (Michigan).

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The Wyoming Highway Department has been employing 47 snow plows in snow removal work covering 2600 miles of state highway and has had reasonably good success judging by the reaction of the motoring public, according to Z. E. Sevison, State Highway Superintendent.

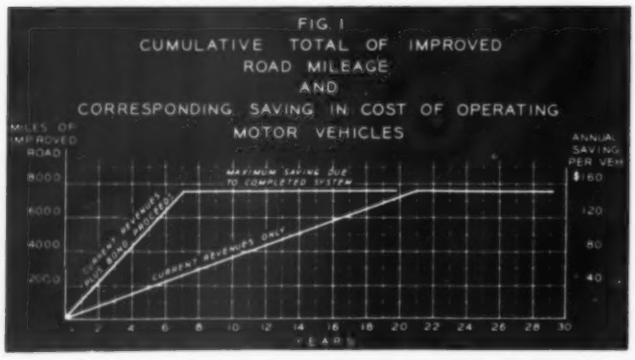
The Economy of Paying INTEREST ON ROAD BONDS

By R. C. BARNETT

Statistician, Missouri State Highway Department, Jefferson City, Mo.

THE question is often asked, "Why pay interest on road bonds? Why not build roads out of current revenues?" The inquirer overlooks the fact that the justification for the large investment in good roads is that they save the motor vehicle owners a considerable percentage in the cost of operating their vehicles, and that this saving is greater when construction is rapidly carried on. A brief analysis will show the true economy of building roads at a faster rate than current revenues usually permit.

Transportation Costs.—It has been quite definitely determined that the modern concrete road, compared



with the ordinary dirt road, reduces the ton-mile cost of transportation 2.6 ct.; likewise the gravel road when well maintained reduces the cost 1.6 ct. Here is an average reduction of 2.1 ct. per ton-mile for vehicles operating over the state system.

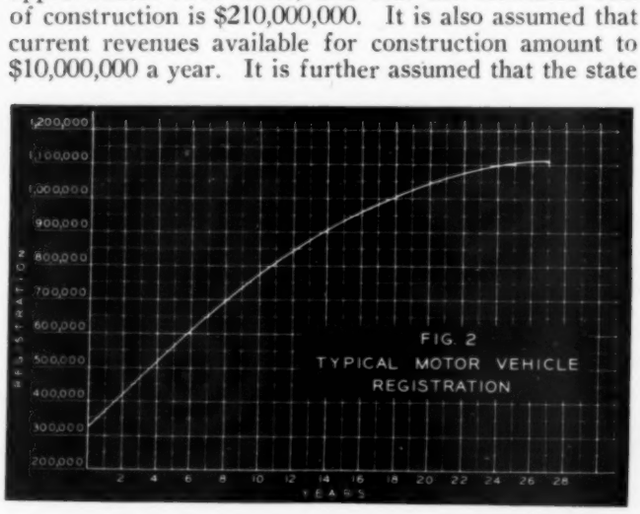
The ton-mile unit of transportation is closely approximated by the Ford or the Chevrolet car carrying two passengers. Since 80 per cent of our motor vehicle registration is in this class, we may well take the car-mile as equivalent to the ton-mile. To be conservative, we will also consider that the average improved road on the state system saves the motor vehicle owner 2 ct. per car-mile.

The capital investment required for the average mile on the state system in Missouri is $28,200. The interest rates carried by the various issues of our state road bonds range from 3½ to 4½ per cent. At the average rate of 4 per cent, the annual interest charge on the capital investment per mile amounts to $1,128. To offset this interest charge, there must be sufficient traffic over the average mile of highway to effect an aggregate saving of $1,128. In other words, the annual car-miles of transportation must equal $1,128 divided by 2 cents, or 56,400 car-miles a year, or 154 vehicles each day. The average mile of the Missouri state highway system carries a daily traffic of 1050 vehicles, or 6.8 times this minimum limit.

The daily saving for the 1050 vehicles amounts to $21.00; the annual saving is, therefore, $7,665 or 6.8 times the annual interest charge. Herein lies the economy of borrowing money to speed up the road program and thereby secure, to the motor vehicle owners who in the end pay the bills, the relatively large saving in the cost of operation.

Two Methods of Financing Compared.—The accompanying diagrams have been prepared for the purpose of illustrating the principal features of the two methods, and so enable the reader to draw a comparison between them. Obviously the two methods cannot operate at the same time, and consequently actual experience does not afford the opportunity for comparing under like conditions the two different programs. It is necessary, therefore, to set up standard conditions in place of the special and peculiar conditions exisiting in any one state and in so doing to ignore some of the minor factors. In this way only can we get a sound basis for comparing the two methods. While the following assumptions are not strictly identical with the conditions that prevail in Missouri, nevertheless, they resemble in a general way such conditions.

It is first assumed, that the designated state system approximates 7500 miles, and that the estimated cost of construction is $210,000,000. It is also assumed that current revenues available for construction amount to $10,000,000 a year. It is further assumed that the state



highway department can efficiently manage $30,000,000 worth of construction work each year. It is thus seen that, on the "pay-as-we-go" plan of spending $10,000,000 a year, it would require 21 years to complete the system. On the other hand, if bonds were sold at the rate of $20,000,000 a year, a total annual revenue of $30,000,000 would result and the system could be completed in seven years.

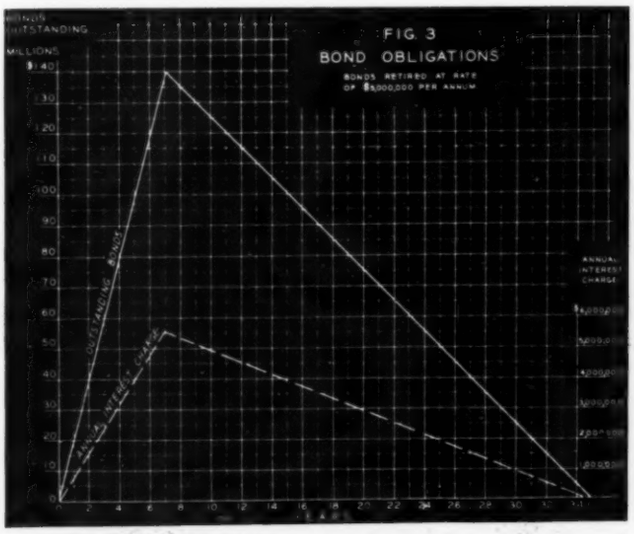
While this road system is in the process of construction, it is being used by an increasing number of motor vehicles. As the road system approaches completion, these motor vehicles are able to operate at less and less cost to their owners. When the total mileage is improved, the annual saving will be the same under either method. From this saving in operation cost must be

deducted the annual interest charge, in the case of the bond issue program.

Variables Involved in Problem.—We thus have four principal variables to deal with in solution of our problem, namely:

The time expressed in years,

The increasing amount of road mileage,

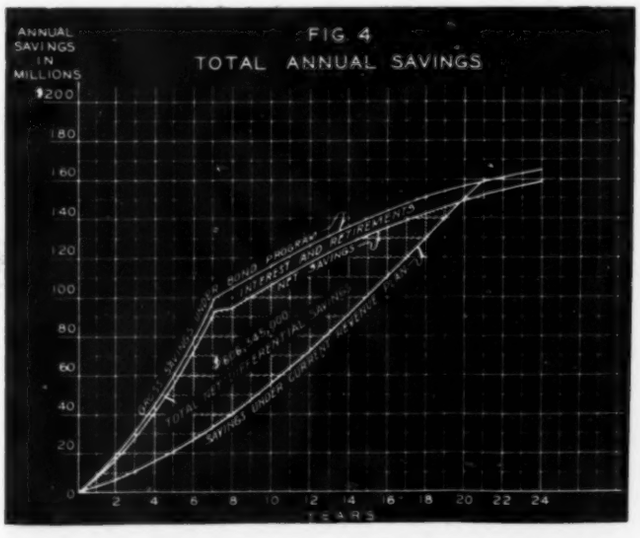


The increasing number of motor vehicles used on the road, and

The increasing interest charge as more and more bonds are sold during the period of construction.

Figure 1 shows the mileage of improved roads at the end of each year and the term of years needed for the completion of the road program under each method. It further shows the annual saving per car at the end of each year resulting from such improved road mileage.

Figure 2 shows the automobile registration at the ends of the several years involved in the construc-



tion program. It must be remembered that experience indicates a diminishing rate of increase for such registration.

Figure 3 shows the bond obligations incurred under the bond program. During the construction period, it is assumed that $20,000,000 of bonds are sold annually in order to supplement current revenues and make the total construction funds available, amount to $30,000,000 each year. It is readily seen that, after the period of construction, the current revenues which no longer will be going into construction will be available for other purposes. The retirement of the bonds is, therefore, assumed to start at the close of the construction period, and to proceed at the rate of $5,000,000 a year until the bonds are paid off. This diagram also indicates the annual interest charge as it varies from year to year.

Figure 4 shows the total savings accruing to the motor vehicle owners from the increase each year in the total of improved road mileage, and also from the increase in motor vehicle registration. The lower curve pictures the savings resulting from the current revenue plan. The upper curve, corrected for the interest charge, shows the savings that result from the speeding up program which is obtained under the bond issue plan. The shaded portion of the figure indicates the net differential savings accruing to the motor vehicle owners through the adoption of the bond issue plan. It is observed that the net differential saving is of considerable magnitude amounting to $606,545,000 as compared with the total cost of the system; namely, $210,000,000. Herein lies the economy of expediting road construction through the issuing of bonds.

Data Upon Which Charts Are Based.—The following tables set out the data upon which the charts are based.

SAVING IN OPERATION COST CURRENT REVENUE PROGRAM

Year	Miles Complete	Saving per car	Motor Registration	Total Savings
1	360	$ 7.20	370,000	$ 2,664,000
2	720	14.40	425,000	6,120,000
3	1080	21.60	470,000	10,152,000
4	1440	28.80	515,000	14,832,000
5	1800	36.00	565,000	20,340,000
6	2160	43.20	610,000	26,352,000
7	2520	50.40	655,000	33,012,000
8	2880	57.60	695,000	40,032,000
9	3240	64.80	735,000	47,628,000
10	3600	72.00	775,000	55,800,000
11	3960	79.20	810,000	64,152,000
12	4320	86.40	845,000	73,008,000
13	4680	93.60	875,000	81,900,000
14	5040	100.80	905,000	91,224,000
15	5400	108.00	935,000	100,980,000
16	5760	115.20	960,000	110,592,000
17	6120	122.40	985,000	120,564,000
18	6480	129.60	1,005,000	130,248,000
19	6840	136.80	1,025,000	140,220,000
20	7200	144.00	1,045,000	150,480,000
21	7500	150.00	1,065,000	159,750,000
				$1,480,050,000
22	7500	150.00	1,075,000	161,250,000
23	7500	150.00	1,090,000	163,500,000
24	7500	150.00	1,100,000	165,000,000

SAVING IN OPERATION COST—BONDS AND CURRENT REVENUES

Year	Miles Complete	Saving Per Car	Motor Registration	Total Saving	Annual Bond Obligations	Net Savings
1	1070	$ 21.40	370,000	$ 7,918,000	$ 800,000	$ 7,118,000
2	2140	42.80	425,000	18,190,000	1,600,000	16,590,000
3	3210	64.20	470,000	30,174,000	2,400,000	27,774,000
4	4280	85.60	515,000	44,084,000	3,200,000	40,884,000
5	5350	107.00	565,000	60,455,000	4,000,000	56,455,000
6	6420	128.40	610,000	79,324,000	4,800,000	73,524,000
7	7500	150.00	655,000	98,250,000	5,600,000	92,650,000
8	7500	150.00	695,000	104,250,000	10,400,000	93,850,000
9	7500	150.00	735,000	110,250,000	10,200,000	100,050,000
10	7500	150.00	775,000	116,250,000	10,000,000	106,250,000
11	7500	150.00	810,000	121,500,000	9,800,000	111,700,000
12	7500	150.00	845,000	126,750,000	9,600,000	117,150,000
13	7500	150.00	875,000	131,250,000	9,400,000	121,850,000
14	7500	150.00	905,000	135,750,000	9,200,000	126,550,000
15	7500	150.00	935,000	140,250,000	9,000,000	131,250,000
16	7500	150.00	960,000	144,000,000	8,800,000	135,200,000
17	7500	150.00	985,000	147,750,000	8,600,000	139,150,000
18	7500	150.00	1,005,000	150,750,000	8,400,000	142,350,000
19	7500	150.00	1,025,000	153,750,000	8,200,000	145,550,000
20	7500	150.00	1,045,000	156,750,000	8,000,000	148,750,000
21	7500	150.00	1,065,000	159,750,000	7,800,000	151,950,000
				$2,236,395,000	$149,800,000	$2,086,595,000
22	7500	150.00	1,075,000	161,250,000		
23	7500	150.00	1,090,000	163,500,000		
24	7500	150.00	1,100,000	165,000,000		

Gravel Aggregate Bituminous Macadam Laid By Village

INCREASING interest in low cost road construction has brought forth numerous plans for placing wearing surfaces on existing compacted dirt and gravel roads and streets. One of the successfully applied types, known as bituminous macadam made from gravel, is being extensively tried out because it offers a finished hard pavement at a cost of about $5,000 per mile. This class of material, produced from bank run gravel, is being used in several states. Such pavements can be laid at about one-quarter of the cost of portland cement concrete standard state specification pavements and half the cost of older bituminous preparations.

This bituminous macadam consists of bank run mineral aggregate screened to remove stone over ¾ in. and mixed with the proper percentage of bitumen. It is laid either hot or cold, depending upon the kind of bituminous compound employed. It is mixed at the plant set up in the gravel pit.

A project of considerable size has been recently completed by Claude B. Talbot, a contractor of Detroit, in paving approximately 50,000 sq. yd. of city streets in the village of Rochester, Mich. This is a town of about 5,000 population, 26 miles northeast of Detroit. Most of its streets were graveled over natural earth base and

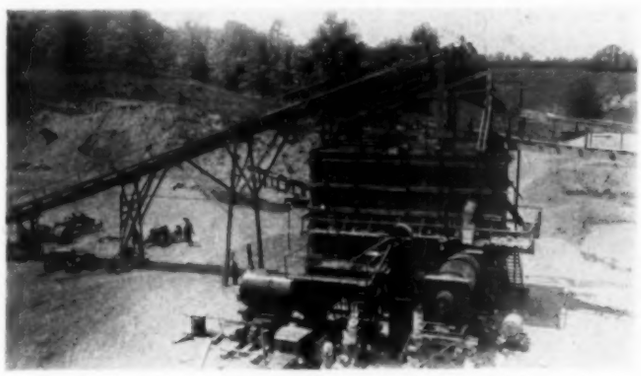
Plant Set Up in Gravel Pit. Note That Portable Plant Is Cribbed Up and Truck Runway Dug Below Pug Mill

had become solidly compacted by traffic. The main street had been paved with portland cement concrete, being a state route to North Michigan points. Each year the village expended considerable sums of money for calcium chloride and for other dust laying programs. With a good gravel producer adjacent to the town and noting the success of the adjoining county with bituminous macadam pavements using gravel aggregate, the village council decided to pave most of the main residential streets during this past summer.

A contract was let to Mr. Talbot for about two miles of work, but as he progressed the people of Rochester were so well satisfied that they increased their order to approximately 50,000 sq. yd. and have intimated that they will complete the entire city in 1932.

The preliminary work included grading over streets to remove surplus dirt or gravel, provision for drainage at intersections, proper regard for present or future curbs; all to allow for a top coat of bituminous macadam 3 in. thick, laid loose, and 2½ in. thick when compacted. The streets were opened to traffic a couple of hours after rolling.

Gravel was obtained from the pit of John G. Kemler, 3 miles from the town. No special processing was necessary. Carried by belt conveyor from the bank to the top of the bins, it passed through screens to exclude stone over ¾ in. in size but it was not washed. It contained normal moisture, not over 5 per cent, and was fed directly into the contractor's portable heating and mixing plant. The plant is standard portable equipment manufactured by the Chausse Oil Burner Co., Elkhart, Ind. Mr. Kemler's sub-contract included hauling the hot mix in steel body dump trucks 3 miles to Rochester. These bodies were kept oiled to prevent



General View of Plant Showing Arrangement of Units

sticking and the loads covered with canvas enroute to retain heat.

Aggregate from the pit bin fed directly into a large hopper, from which it passed into the rotating sand drier. It was thoroughly dried, heated to about 300 deg. F., and discharged into an elevator attached to the mixing unit. In the illustration the two portable units are shown cribbed up to proper height which was necessary because the high water level in the pit prevented digging a deeper runway for loading the trucks.

The elevator raised the heated aggregate into a self-measuring device and thence into a continuous blade type pug mixer. At the same time, the bitumen which was being heated in the 950 gal. tank was pumped into a measuring device connected to the aggregate measure. The asphalt measure was adjustable so that any amount of bitumen up to 10 per cent could be admitted into the

Laying the Hot Bituminous Macadam Pavement. Pit Run Gravel ¾ In. and Less Was the Mineral Aggregate

pug mixer. For the Rochester job about 5 per cent to 6 per cent asphalt was used.

From the pug mill, the hot stuff dropped into a storage bin which has a movable bottom gate that could be operated by the truck driver. The plant can be as well used in making standard formula asphalt paving mixes, using crushed rock and sand, and either for hot or cold laying.

The method of installing the asphalt plant right in the gravel pit next to the gravel bins worked out admirably as the only hauling necessary was of the finished product to the points of application. The haul of 3 miles caused practically no loss of heat and it is felt that a haul of 15 to 18 miles is entirely feasible. The material was laid at an average temperature of 275 deg. F.

About half a day is needed to make the plant ready for hauling to any other location and in about a day it is ready for complete operation.

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Snow Removal Methods in Van Buren County Michigan

By H. M. WARD
County Highway Engineer

THE history of active organized snow removal on rural roads in this vicinity dates back to 1925, at which time the state highway department took definite and forceful steps to make its state trunk line highways available for motor traffic during the winter season. During the winter of 1925-26 the roads designated for this type of maintenance comprised a total of 54 miles in our county. This service to the travelers on our highways met with instant approval, followed by an insistent demand that all improved highways be cleared of snow to permit constant use by motor vehicles. During the following winter, the state highway department carried out snow removal on all state roads in our county. This comprised at that time a total of 68 miles. In addition, our county road commission decided to remove snow on approximately 100 miles of the most important secondary roads. The instant popularity and economic value of this work warranted further expansion, until now the state highway department is carrying on regular winter maintenance on all state trunk line roads in this county (104 miles), and our county road commission clears snow from the entire county road system under its jurisdiction, which comprises 227 miles. The balance of the public roads are under township jurisdiction, and some scattered efforts are made by those organizations to do some work of this kind on their 1,060 miles of side roads.

The problem from a county angle has been one of ways and means to finance the work. Our board operates on the general principle that our share of the apportionment of the vehicle and gas taxes should pay all maintenance charges. Hence we were confronted with an increase in maintenance expense which was greater than the normal increase in revenues. It was evident at the outset that purchase of high cost heavy duty snow removal equipment solely for winter maintenance was impossible of realization. Accordingly, we set out to equip all of our trucks rated at two tons or greater capacity with detachable truck plows ranging in price from $575.00 to $720.00 each. We now have twelve units of this type in operation and find them efficient in service and low in operating cost for this type of work. The small added investment for each plow made a year round maintenance tool for all our heavier truck units.

We find it impossible to combat all local snow conditions with these units, because of a large number of locations where excessive drifting invariably prevails. Our solution for these conditions consisted in drift prevention work in the form of snow fences which are placed adjacent to the drift areas at the beginning of winter and removed about April 1 of each year. We now have a total of approximately eight miles of snow fence and believe that an additional four miles of this type of protection will cut down drifting to a minimum height which can be handled by our fast truck plow units.

We prefer truck units with a rated capacity of three tons or more for the power units, and can give reasonably prompt service with an average of one such truck and plow unit to each twenty miles of road.

Most methods of accomplishing various tasks have limitations, and our work as outlined above is hampered as the winter season progresses by the snow bank or furrow which is thrown up at the edge of the road by successive plowings to remove later snowfalls. For this condition I believe a heavy duty snow removal unit which will break up heavily packed or frozen snow and discharge it outside the highway is the proper solution. Such a unit operated as an auxiliary leaves the necessary storage place for the next successive plowing by the lighter units.

Successful snow removal with our set-up of equipment depends primarily upon liberal use of snow fence, and then upon starting the plows with a storm and KEEP GOING. You no doubt have heard the Chinese description of a street car, which is something like this: "No pushee, no pullee, but goee like hellee allee timee, by golly." My version of snow removal under the above outlined method is to start with the first flake, then "All pushee, no pullee, and plenty much goee."

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Our "Food" Roads

While residents of rural communities and those of towns and cities have different ideas about good roads, there is no conflict. Town and city dwellers see only the main highways, but the farmer sees his own and all roads, improved or unimproved, as arteries of commerce. If West Chicago residents will pause to reflect a moment they'll agree that the farmer's view is right. Not very much work would be done in this country if roads were used for joyriding. Most side-roads are really "food" roads in that they link nature with the kitchens of cities and towns. Over them pour fruits and vegetables, dairy products, cattle, hogs, grain and poultry, to be sold for the payment of individual debts, and for purchases that are hauled back to the farms. These roads must be kept in good condition. They do not need to be paved with the finest of material. But in all cases they need plenty of gravel, continuous upkeep and treatment with oil when funds permit. The town or city resident who fails to realize this is blind to the interest of his own community.

Acknowledgment.—This article appeared as an editorial in the *West Chicago Press.*

Present Status of State *Highway Work*

By W. C. MARKHAM
Executive Secretary, American Association of State Highway Officials

ON the first day of July there was one person employed on state highway work for every 369 people in the nation. The largest number employed in any state at that time was one out of every 70 persons in the state of Maine. This has no reckoning of persons employed in road work by townships, counties, or cities, neither does it have anything to do with persons who are employed exclusively in preparing materials to be used in road construction. Likewise this has no reference to people employed by the Federal Government in road work; whether departmental, in forests, Indian reservations, public domain or national parks.

In addition to all this, the fact should not be overlooked that there are many industries scattered throughout the country which would have been closed down if it had not been for the demands made upon them to furnish materials for this road building program.

States Increase Road Building.—There have been a number of newspaper stories emanating from several sources as to the highway contracts let by the state highway departments during 1930 and making estimates as to the contracts for 1931. In making this comparison instead of using the actual accomplishments of 1930 they used estimates previously made for the year 1930.

In making a comparison between these two years, in order to see whether the states are lagging in their work, I have made a study of the first six months of these two years. This is done first because we have all of the facts concerning this period of time and second because due to the federal loan, the contracts for 1931 are without question centralized in this six months period. A comparison of the contracts let during these two periods shows that almost $115,000,000 more contracts were let in the first six months of this year than last year; and all of this despite the fact that it came at a time when 42 legislatures were in session and many efforts were made, and some definite changes accomplished, in taking from the state highway funds motor and gas receipts for local roads and cities.

Nevertheless, while we all rejoice in the policy adopted by the Federal Government in making an advanced loan to the states of $80,000,000 which could be used as state funds to match the regular federal funds, it will be a matter of great surprise to those who have been peddling the story that the states have been slow, when they are made to realize that 23 states increased the contracts during this period to an amount of over $64,250,000 above their allotment of the special emergency loan from the Federal Government.

Status of State Road Improvements.—During the past calendar year the states have increased their surfaced mileage on the state systems by almost 26,000 miles but while they were doing that the legislatures added almost 6,400 more miles to the systems and this has nothing to do with the wholesale job accomplished in North Carolina or the new-idea township undertaking in the placid home of William Penn.

In adding to the surfaced mileage during the past year the types of roads were as follows: gravel 5,014, bituminous macadam 1,076, bituminous concrete 1,065, concrete 9,462 and all other types 9,380. We started this year with a state system of 321,723 miles; 29 per cent in pavement, a gain of 3 per cent over last year; gravel 31 per cent, a gain of 2 per cent over last year;

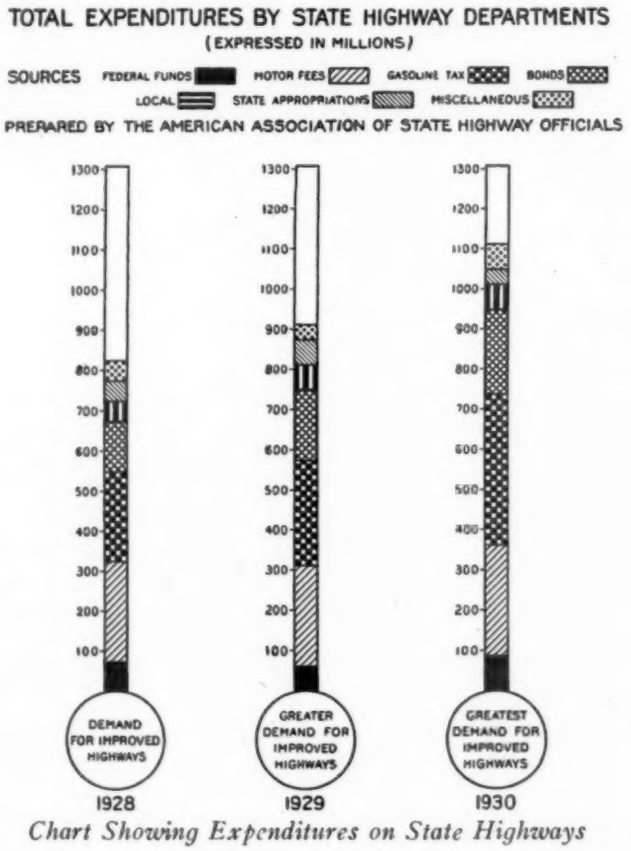

Chart Showing Expenditures on State Highways

sand clay and other types 12 per cent, a gain of 3 per cent over last year. This leaves 28 per cent still earth roads, or a net gain in surfaced mileage of but 8 per cent. However, this remaining 28 per cent of earth roads is 38 per cent graded to standard and supplied with proper small drainage structures.

This association has taken the position, as a financial policy in road building, that there comes a time in road improvements when a state should be obligated to assist the counties in maintaining a definite county system of highways, definitely coordinated with each other and with the state system. The percentages of improvement of the state systems doubtless should be the basis of such procedure. What that percentage should be is a matter for local decision. However, the impatience

to get a larger system of improved highways seems to have overcome the local political powers and in some instances the state authorities have been loaded up with local mileages without a full knowledge of the finances needed or the condition of the state system.

The percentage of surfacing in the several states ranges from 26 to 100 per cent but the state which has but 26 per cent of its state system with any kind of surfacing has a responsibility of maintaining, as a state system, 21 per cent of the entire road mileage. Under normal conditions this state would have its state system 54 per cent surfaced. It would seem therefore that this state is in no position to aid the counties and yet it does.

There are 28 states which claim that over 70 per cent of the state system is surfaced. Of these states 23 are now giving aid to the counties. There are 14 states whose state systems are less than 70 per cent surfaced—from sand clay up—and yet they divide some of the state funds with the counties.

Sources of Income for State Highway Departments.—The total income for state highway department activities for the last calendar year was $1,136,673,437. This is the largest income in the history of road building and does not include cash balances of $286,490,000 distributed among all of the states except one. The receipts came from the following sources: 25.9 per cent from motor license fees, 36 per cent from gasoline taxes, 19.5 per cent from bonds, 5.3 per cent from local authorities, 0.9 per cent from state tax levy, 2.8 per cent from direct appropriations, 1.6 per cent miscellaneous and federal funds 8 per cent. The substantial increase of funds over the previous year came from all sources and therefore while the federal funds increased from $77,572,691 to $96,462,836 the percentage of federal funds to the total was slightly less than in 1929.

State Highway Department Disbursements.—The total expenditures through the state highway departments was $979,997,847, being an increase over 1929 of over $180,000,000. Of these expenditures construction took 62 per cent; maintenance, 16.8 per cent; interest on bonds, 4.4 per cent; retirement of bonds, 6.1 per cent; transfer to local roads, 5.8 per cent; equipment, 2 per cent and miscellaneous 2.3 per cent. While the expenditures for construction average about four times as much as that for maintenance, two states last year spent more for maintenance than for construction. When the year was closed, despite the increased payments made, there were almost $284,000,000 left in the treasuries of the states. However, in four states the funds were entirely exhausted.

Absorption of Federal Funds.—For the fiscal year of 1930-31, which is a six months advance over the comparison made previously in this statement, the federal funds in cash payments to the states were a total of $133,340,911. The next largest payment heretofore was made eight years ago and then it was $35,000,000 less than this year. Compared to their share of the regular federal authorization of $125,000,000 there were 33 states which received cash in excess of this allotment.

The federal funds obligated during this same period shows a wonderful record due to the use of the federal emergency loan as state funds. The obligations were $36,000,000 in excess of a regular $125,000,000 authorization, being $157,952,903. Yet it should be noted that there were 12 states which even then did not enter into project agreements for an amount equal to their share of the regular authorization.

It is fair to presume that the federal funds not under contract on Aug. 1st (the latest date we have found practical to use) which amounts to a little over $30,500,000, will be entirely absorbed before the Congress opens in December. Fourteen states already have exhausted their allotments. It is well known that there is still one more federal authorization to be made, but the law passed granting the emergency loan provides that one-fifth of the allotment shall be deducted each year, beginning with next year and until the $80,000,000 has been returned to the federal government. This will leave therefore really but $105,807,000 to be allotted to the states. This situation makes it clearly evident that if the federal government does not wish to retard its road program, proper provision will need to be made at once.

Roads Outside the State Systems.—Much is being said these days about the need of road improvements outside the state systems, some say too much money is spent on the state roads and that the fellow outside is being allowed to flounder in the mud; also, that one reason why the counties and township roads are not comparable to the state roads, is inefficiency and lack of road knowledge. And then the cities complain because they contribute enormous sums through license fees and gasoline taxes and are not given some of the funds to use on their city streets as they may desire.

There are 7 states which control in whole or part the county road systems. There are 36 states which aid the counties with or without supervision of expenditures. There are 14 states which aid the townships with or without supervision of expenditures. There are 21 states which aid the cities of certain population or on certain streets. There are 7 states in which counties may or do control road work in the townships or "towns" and there are 26 states in which the counties are the smallest unit for road responsibility.

A good road is needed over which to transport a load of wheat or cotton or cattle. The price the merchandise brings is not a measure of the need for the highway. The past years experience shows that an increased road program not only takes the depression out of the highway but it is the base course for many a hearthstone. Every part of our governmental structure has its share of responsibility in meeting the issue. The state highway departments are equipped for an increased task. Those responsible for legislation must either furnish funds for food or work.

Acknowledgment.—The foregoing is an extract from the report presented Sept. 29th at the annual meeting of the American Association of State Highway Officials at Salt Lake City, Utah.

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GOOD ROADS ORGANIZATIONS CREATED IN ARGENTINA.—The Argentine Provisional Government has issued a decree creating a General Directory of Road Consortia to be formed by the general secretary of the public road system and an engineer and representative from the following institutions: Sociedad Rural Argentine, Federacion Agraria Argentina, Asociacion de Importadores de Automoviles y Anexos, Importers and Producers of Naphtha, Argentine Touring Club, Asociacion Automovilista Argentina, Federacion Automovilista Argentina. The functions of the new organization will be to create similar local organizations throughout the country for the construction, betterment, and maintenance of roads; and for traffic regulation. For the furtherance of this plan a fund of about $300,000 will be set aside from the special surcharge on the sale of gasoline.

Bridge Construction Details
Which Are Sometimes Neglected

By W. A. STACEY
Field Engineer, Service Bureau,
American Wood-Preservers' Association

THE technique of treated timber bridge construction is quite simple, but it contains one basic principle that should be kept in mind by engineers engaged in such work. Assuming that proper grades of timber have been selected and that a sufficiently heavy treatment with an approved preservative has been specified, thereafter design and construction methods should be followed which will necessitate a minimum of disturbance to the treated exterior of the materials used. The unavoidable cutting into any preserved unit of such construction should be followed by an adequate field treatment that will render this portion of the unit as durable as the remainder of it, or as nearly so as possible. The principle involved is extremely simple, the cost of field protection to unavoidable field cuts is negligible, and common sense on the part of the engineer in charge will dictate field methods that will be entirely adequate.

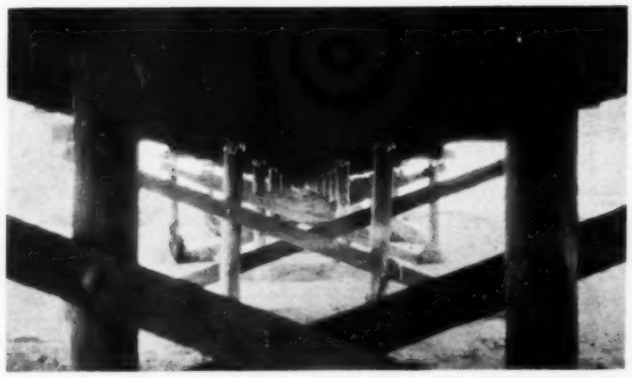
It is noticeable that highway engineers generally protect pile cut-offs under bridge caps very carefully with several coats of hot creosote and pitch followed by a protective roofing of galvanized iron or other material. Nevertheless, in some instances the wing piles at the abutments are left without sufficient protection after having been cut off to fit the top level of the bulkhead plank. By all means should these be taken care of, as the wing piles are more exposed than the other piles under the bridge. The pile top covering of pitch-saturated burlap used by the Nebraska State Highway Department is particularly effective in that it covers the sides of the pile also for nearly a foot, being wired down in that manner.

Standard Pile Cut-Off Protection in Use in Nebraska. After Applying Several Coats of Hot Creosote and Pitch a Covering of Pitch Saturated Burlap Is Wired on Pile

Pile Cut-Offs Which Have Been Coated with Hot Creosote and Roofed with Heavy Tar Paper and Tar

The use of a straight planked abutment is sometimes more desirable than one from which the wings are carried out at an angle of 45 or 90 degs. While in the design of the former type there is no need of cutting the bulkhead material after treatment, the proper use of cleats will also obviate the necessity for framing the plank used in the angle type.

It is not advisable to allow a bridge contractor or foreman to fasten sway braces to piles with one standard length of bolt. If so, you may find him trimming off the sides of the larger piles with an axe and putting untreated blocks of wood under the bolt heads on the smaller ones. Standard designs of the Wyoming Highway Department require the contractor to provide bolts with sufficient threads so that extra washers are not required for a tight fit on the bolts. In no case should



Under View of Very Well Built Creosoted Bridge Showing Pile Cut-Off Roofing. Right Foreground Pile Has Been Cut to Permit Use of a Short Bolt

creosoted piling be adzed or gained to secure an even bearing for the sway bracing. If necessary, treated blocks should be used between the bracing and the pile to form a level bearing.

Preframing and boring of timbers as completely as practicable at the treating plant before treatment is common practice and is recommended. Particularly desirable for a smooth floor is the requirement that all stringer ends be surfaced on one edge for a length of 18 in. to an even depth before treatment.

In some cases caps are secured to the piles by means

Railroad Bridge Bent Showing Treated Blocking to Secure Even Bearing for Sway Brace. All Trimming of Treated Piles Prohibited

of a U-shaped strap iron over the tops of the caps, and the ends of such an iron fastened by bolts or lag screws into the pile. The drift bolt method of fastening caps to piles is the most common.

The following notes are taken from a recent system standard of the Atchison, Topeka and Santa Fe Railway and should be of interest in that they summarize that company's years of experience with treated timber as applied to bridges designed for heavier loadings than are modern highway bridges:

"All timber and piles will have a preservative treatment.

"All timber will be cut to exact length, and surfaced where required, at the treating plant before treatment is applied.

"Caps, stringers and guard rails will be pre-bored before treatment, as per details.

"Treated timber and piles should be handled with extreme care, and so far as is possible avoid damaging the surface by unnecessary use of timber hooks, peavies, etc. When possible, timber should be handled by rope slings, and the dropping or throwing of timber and piles from an excessive height should be discouraged.

"When necessary to disturb the surface of the treated timber and piling or when the surface has been damaged through handling, such surfaces should be mopped with a liberal quantity of hot preservative followed by two applications of hot sealing compound.

"When necessary to bore into treated timber, the hole must be swabbed thoroughly with hot preservative and swabbed again with hot sealing compound and the bolt at once driven home. Pre-bored holes not used, and unused holes bored in the field, shall be fitted with round creosoted plugs. These plugs to be dipped in hot sealing compound before being driven.

"When treating the top end of piles, a liberal quantity of sealing compound shall be poured on before the sheet metal cover is placed. Before placing the cap, the sheet metal cover shall be bent down on the sides and a liberal quantity of lukewarm sealing compound poured on the sheet, and spread over area covered by cap.

"When it becomes necessary to work from scaffolding in constructing the bridge, such scaffolding should be hung from ropes, and not nailed to the timber or piles.

"Metal sheets protecting caps, stringers, and piles, are covered by details on standard plan.

"All nuts, heads of bolts and tops of washers shall be painted with two coats of approved bridge paint just before completion of the work. Stringer and cap anchors shall be given two coats of approved bridge paint before being placed in position, and shall receive a third coat just before completion of the work."

Those resident engineers of State highway departments and those county engineers who enforce in detail the simple basic principle embodied in wood preservation will build permanent timber structures that are free from maintenance. Their work will stand thereafter to their credit.

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The *Proceedings* of the American Road Builders' Association this year are published according to a new plan. Instead of publishing complete reports, summaries and conclusions only are presented so that much information may be obtained with little reading. The full reports are published as bulletins. These *Proceedings* have been adopted as a standard reference work in many technical schools.

Highway Accidents *and the* Road Hog

By EARLE BROWN
Chief Patrol Officer, Minnesota Highway Department

THE MORE I SEE of the highway traffic problem, the more I study the causes of motor vehicle accidents, the more I am convinced that while there are many sides to this question the trouble back of it all can be summed up in two words: "Road Hogging."

The accidents which result in death or serious injury are usually due to the violation of one of a few fundamental rules of the road, rules which have been written into the Uniform Vehicle Code of the National Conference on Street and Highway Safety and which are a part of the law in all or nearly all the states. I refer to such practices as driving beyond the left of the center of a road which has two or more lanes, contending for the right-of-way at intersections, passing other cars on the crest of a hill or at curves or intersections where the view is obstructed, making left turns without an adequate signal, weaving in and out or cutting in on other traffic, parking on the traveled portion of the roadway, passing street cars taking or discharging passengers, driving with glaring or improperly adjusted lights.

Everyone of these errors shows evidence of a disregard of the rights of others on the road. The driver who commits these errors is not treating other drivers as he would have them treat him. He is guilty of discourtesy of the worst kind. An error of conduct in the home or the office may hurt one's feelings, but if it is unintentional, it may be righted by an apology. Usually you can quickly escape the social boor. But there is no escape from the boor behind the steering wheel. Friends riding with him in his own car, strangers meeting him on the road, are alike at his mercy, and he leaves wounds which can never be healed, and vacancies in the family circle which can never be filled.

When we speak of a road hog, we usually think of a person with a big car or truck going down the middle of the highway and forcing other drivers to take the ditch or stay behind him. Such deliberate misconduct is of course inexcusable, but in its consequences it is perhaps not as serious as thoughtlessness. Such a driver at least gives plain notice of his hoggishness, and the driver of a smaller vehicle who contends with him for the road is simply fool-hardy. But when we meet a car on the wrong side of the road at the crest of a hill, when the car ahead of us makes a sudden left turn without a signal, when he starts weaving in and out of congested traffic, we have no time nor opportunity to get out of his way, and it is just luck if we escape an accident.

Usually these things are not done deliberately but thoughtlessly. The driver who takes the trouble to consider the matter at all would know that when violating most of the rules in the traffic code, he is endangering himself as much as others.

Misconduct on the road becomes all the more astonishing when we consider that much of it is committed by intelligent, educated persons, who have a high code of ethics and courtesy in their business dealings and their social conduct. Why they should become such boors when they get behind the steering wheel is difficult to understand. A large share of accidents, it is true, are caused by persons who are mentally or physically deficient, and who should never be permitted to drive a motor vehicle. Some are caused by business and professional men who permit their minds to wander into other fields, and who forget to keep their mind on their driving. But many others are caused by persons who, although of normal intellect, do not have any weighty problems on their mind. In many cases they do not realize the inherent danger in a modern motor vehicle. Perhaps they are hypnotized by the smoothness and power of their car. Whatever it is, thoughtlessness sooner or later leads to serious consequences.

What is the remedy? A carefully trained highway patrol on the rural highways, with similarly trained traffic officers in the municipalities, can go a long way toward correcting driving errors. Efficient traffic control requires careful selection and thorough training of the men. It also requires the right perspective. Nothing is gained by trying to make a record for a large number of arrests, by arrests from ambush, or by arresting or annoying drivers who commit technical but comparatively harmless violations of the traffic act. But a traffic patrol can be a real help if it will get the confidence of the motoring public. To do this the men must make it clear that in calling attention to driving errors, they have in mind the safety of the driver just as much as others on the road.

"Keep Traffic Moving Safely," has been the slogan of the Minnesota Highway Patrol. We started with nine men in 1929, increased to 35 last year, and since the first of June this year we have had 70 men. Already we see a marked improvement in driving conditions on our highways. There is less driving in the center of the road, less passing on hill-crests and turns, less parking on the roadway, and fewer of nearly all other driving errors. The visible presence of uniformed officers on the highways has a good effect, and it tends to keep drivers on the alert, even if they are never even given a word of caution by the patrolmen.

But the patrol alone cannot solve the accident problem. It is only one means of attack. No matter how many men you have, they cannot be everywhere. They cannot begin to give individual attention to the drivers of our now universal motor vehicle. Nor have they any assurance that a man arrested or warned for a violation of the traffic act will not commit the same error again.

A well-drawn driver's license law such as provided by Act III of the Uniform Vehicle Code, "A Uniform Operators' and Chauffeurs' License Act," would undoubtedly be a big help. Properly conducted examinations would prevent many of the unfit from receiving licenses. The power to revoke licenses would remove some others, while the possibility of the loss of their license would make others alert and careful.

Education must be the final solution. Drivers must be taught both the specific rules of the road, as well as the necessity of observing the Golden Rule, both for their own safety and the safety of others. They must understand the general principles of mechanics of their vehicle. Perhaps this must come through the public schools. Perhaps some day no one will be permitted to drive until he has gone through a course of study in auto mechanics, road rules and courtesy. When every

driver thoroughly understands his machine and his responsibility to others, our accidents will be cut to a mere fraction of what they are now, and the work of traffic regulation will be greatly simplified.

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Many New Bulletins Published by the American Road Builders' Association

New bulletins are in preparation by the American Road Builders' Association for distribution to members, selected roads and street officials, contractors and manufacturers who have been active in Association work. These bulletins contain the complete committee reports presented at the 28th Annual Convention and Road Show held this year in St. Louis to be printed this summer. The bulletins also include research work done for the committees by staff engineers of the association.

The present list includes bulletins as follows:

Highway Finance and Administration—24 pp.

Traffic—24 pp.

Standardization of Steel Forms and Weighing Devices—16 pp.

Highway Maintenance by Contract.

Maintenance Equipment Needs—40 pp.

Snow Removal and Equipment.

Grading Methods and Equipment—40 pp.

Standardization of Methods of Purchasing Equipment—14 pp.

Central and Truck Mixed Concrete—16 pp.

Guard Rail—45 pp.

Highway Location—80 pp.

Airport Surfacing and Drainage—32 pp.

Motor Freight—42 pp.

Highway Building and Federal Employment, Address by T. H. MacDonald—8 pp.

Railway Grade Crossings—30 pp.

Other bulletins are available to road and street officials and contractors until the supply is exhausted and may be obtained by writing to the American Road Builders' Association, National Press Building, Washington, D. C.

The list of bulletins available now includes:

Practical Application of Recent Highway Investigations.

Grade Crossings.

Traffic.

The Regional Area, Its Traffic and Engineering Problems, the Responsibility of the Engineer.

Surveys and Planning.

Economic Surveys and County Planning.

Use of High-Early-Strength Cement in Highway Work.

Depreciation of Equipment.

A Study of Liens in Public Construction.

Rural County Highway Maintenance.

County Construction and Maintenance Equipment.

Standardization of Methods for Purchasing Equipment.

Standardization of Weighing Devices for Concrete Aggregates.

Regional Plans and Surveys.

Design and Construction.

Grade Crossings and Low Cost Bridges.

Highway Nomenclature—Spanish.

These bulletins have been distributed to many thousands of people interested in roads and streets as a service to the cause of better highways.

California Builds Smooth, High Quality Pavements

The California Division of Highways recently released figures on road construction for 1930. Many new state construction records were made during the year and it is probable some of them are world records. A total of 117.3 miles of portland cement concrete pavements was constructed in 1930 in comparison with 102.4 miles in 1929.

The public today demands pavements "as level as a floor" to permit comfort at driving speeds of 50 to 60 miles per hour. California has recognized this public demand and is now building them almost "as level as a floor," although each year sees improvements in surface smoothness.

Upon the completion of each project, its roughness is measured by an instrument called a "vialog." The instrument records the inches of vertical roughness per mile of pavement. The record in 1930 was 4.8 in. per mile and was made on two portland cement concrete paving jobs, one north of Santa Maria in Santa Barbara County, and the other at Liberty Grade in Los Angeles County. The resident engineers were W. J. Cobin and T. W. Voss. There is keen competition all year among contractors and engineers to make the best records because these records are entered to the credit or debit of the contractor and may influence his receiving awards for new work. The average roughness of all portland cement concrete pavements built in 1930 was 8.6 in. per mile. This compares with 14.8 in. of roughness per mile on the 1925 work.

A roughness of 4.8 in. per mile of pavement is an average roughness of only ¼ in. every 275 ft. That it is almost "as smooth as a floor" can be realized by comparing this with smoothness specifications. Most highway specifications require that the pavement shall be so smooth that it will not show a variation of over ¼ in. on a 10-ft. straight-edge; yet they build them so smooth in California that there is only an equivalent roughness of ¼ in. in 275 ft.

The season record for placing pavements was made by Jahn & Bressi, contractors, on the Balboa Avenue-Torrey Pines Road in San Diego County. They placed a daily average of 935 ft. of standard portland cement concrete pavement during the time it took them to build the project. The average production per day for all portland cement concrete paving jobs in the state was 698 ft.

Another interesting record was made on the average strength of portland cement concrete pavements. The average crushing strength of all concrete was 4,942 lb. per square inch, an increase of almost exactly 1,000 lb. over the 1929 average. There was also less variation in crushing strengths than ever before.

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TUNNEL AND VIADUCT ROAD.—One of the most difficult road construction jobs ever carried out in north Wales is that of building a mountain high-road tunnel at the Penmaenbach headland which juts dangerously into the existing coast road. Blasting is done in the night hours and at 4 a. m. a fleet of motor trucks arrives, so that the main road can be cleared before 6:45 a. m., the hour at which it must be re-opened for traffic. A roadway and footpath 34 ft. wide and 21 ft. high, illuminated perpetually by electric light, will be driven through the headland distance of 565 ft. and the summer of 1932 will see it completed.

City Triangulation

By MAJOR DOUGLAS H. NELLES, D.L.S., M.E.I.C.

THE author's intention is to show the necessity for using methods of primary accuracy in city triangulation, and also the necessity of designing a traverse net at the same time as the triangulation net is designed and the stations located. In fact, the traverse net must, of necessity, be designed at the same time as the triangulation net if the triangulation is to be used economically and scientifically for its function of control. Under the system described, it so happens that the triangulation monuments and traverse reference monuments, make first-class city precise level net bench marks, and the arrangement is such as to give ideal net conditions for the control of the secondary level net. It is, therefore, desirable, whenever possible, that the precise level net should not be surveyed until the triangulation monuments, arranged according to the scheme outlined herein, have been constructed.

The fundamental value inherent in triangulation covering large areas is that it can determine the position of points on the earth by co-ordinates of latitude and longitude. A monument holding a position so determined can be replaced with the exactness of the original determination, if at any time in the future it is destroyed. Its position on the earth's surface is not dependent upon its relative distance from local objects. The essential utility of triangulation is that it can be used economically to determine accurately the position of points situated some distance apart, say from half a mile to 100 miles, where the cost of a ground survey between these points of the same accuracy would be prohibitive. When the ground survey is started from, and closed upon, a triangulation station, it can be made at a reasonable cost, using methods such that when the fixed points of the survey are adjusted for the closing error the accuracy of their positions will come within the requirements of their use. When triangulation is used for the determination of short lengths, such as points at each end of a proposed tunnel through a mountain, it is not generally the practice to calculate the positions of these points in co-ordinates of latitude and longitude. They are generally calculated as co-ordinates of latitude and departure.

City triangulation is used as a control to check the accuracy and co-ordinate the surveys of drainage systems, water supplies, roads, harbors, land subdivisions and all other classes of engineering work. In association with triangulation, a traverse net is generally used as a connecting link between it and other surveys, so that all may be adjusted to one datum. In the control and adjustment of such a net, city triangulation finds its greatest use. The traverse net will be of most value when it leaves a permanent mark or station, consisting of a concrete pier and sub-pier with bronze tablets, marking the point, or a semi-permanent mark consisting of a copper bolt cemented in a concrete sidewalk, on one corner of each street intersection. The positions of the traverse stations are calculated by latitudes and departures, the zero of which is a centrally located triangulation station. The bearings of the traverse lines are based upon a "traverse datum line" passing through the zero station and making a known angle with the geodetic meridian passing through that station. The position of any station of the traverse net, any land subdivision post, monument or other object the position of which has been determined by the traverse net in terms of latitude and departure, can with this data be evaluated in terms of latitude and longitude when necessary.

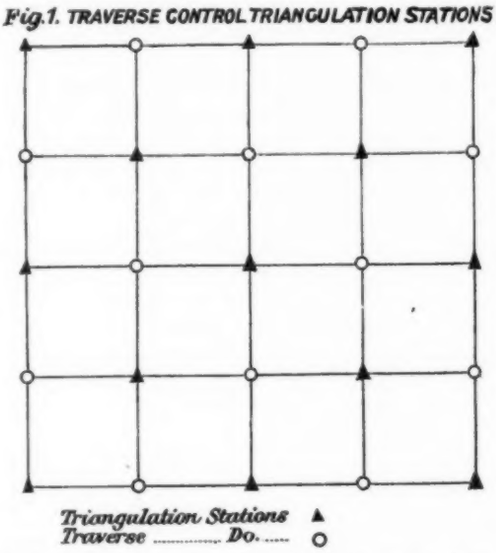
The practical utility of geodetic control for city engineering work is summed up in the following quotation from Special Publication No. 91, of the United States Coast and Geodetic Survey: "All serious problems relative to surveys that perplex the city engineer, have their origin either in the diversity of the data used at different times, or even during the same period, or lack of standardizing the tapes, with the consequent different tape lengths used over different periods, and last, but not least, the lack of proper geodetic control to prevent accumulation of errors and permit the co-ordination of the various fragmental surveys. If different cities would get on a mean sea-level datum, keep their tapes standardized, and tie into and use geodetic methods and control available, then indeed the way of the surveyor would be easy and the burden on the taxpayer's pocketbook considerably lightened."

There are two main considerations in deciding upon the accuracy of city triangulation, namely the cost which increases with the degree of accuracy, and the use for which the triangulation is intended; the latter should receive the greater consideration. For any city, the triangulation should be of such an accuracy that it can be used for the control of all engineering problems of the city. Firstly, as a control for locating lost land monuments which had previously been placed on a latitude and departure basis; secondly, as a control for a map of the city on a scale of about 1/1000, showing buildings, fences, sidewalks and other details, together with 2.5 ft. contours; and thirdly, as a control for all other engineering works, such as water supply, sewerage, roads, etc. For all these purposes the accuracy should be in the neighborhood of 1/100,000.

The first step is to locate triangulation stations in parallel rows, as nearly as local conditions will permit, in the form of the ideal scheme as shown in Fig. 1. These are the stations to which the traverse lines are directly connected, and may be called "traverse control" stations. The primary object of their location is to give strong control to the traverse lines. The next step is to locate triangulation stations which may be called "step down" stations. They may be located inside or near the city, but should be located with the object of forming strong geometrical conditions with the primary triangulation stations from which their positions are determined. They should also be arranged to form strong geometrical conditions with the traverse control stations the positions of whch they in turn determine. They bring the long lengths of the primary lines down to the intermediate lengths which are capable of strongly controlling the short lengths of the traverse control scheme. A step down station may be used for a traverse control station when it happens to fall in a suitable place, but should not be located with that end primarily in view. Lines passing near smoke stacks or tall buildings should be avoided, where possible. Tall buildings themselves form good locations for step down stations in regard to height, but are not altogether satisfactory owing to errors of angle observation introduced by street traffic, movements of elevators and the bend-

ing back and forth of the building, due to the heat of the sun's rays during the day and its absence at night. These effects are are being investigated, and will in the future have to be taken into consideration when dealing with angle conditions in the net adjustment. The angles of the step down stations, traverse control stations and connected primary stations should all be measured with equal accuracy. Fig. 2 gives an idea of the general layout of scheme such as described.

Fig.1. TRAVERSE CONTROL TRIANGULATION STATIONS



The stations of the triangulation of Canadian cities in the past have been from one to three miles apart. This distance was found to be too great for the proper control of the city traverse net. In the adjusting of the errors of a traverse line, it is generally assumed that the closing errors have been cumulative, and that the same amount has occurred at each station; this is not strictly true. The tendency in long lines where greater errors have occurred in some sections than in others, is toward an error in the adjusted values of the positions of certain stations which is greater than is allowable by the chosen standards of accuracy. A city traverse net, which leaves one station on one corner of each street intersection, will be comprised by about 1,200 stations, in a city having a population of about 61,000 and having an area of about 12 sq. miles. Larger cities will require more stations in proportion. It is possible to adjust such a net by the method of least squares, which would bring all stations within the set limits of error, but it is not practical on account of the time required. By a new combination of office and field methods in the traverse survey and in the location of the traverse control stations, it is possible to increase the speed and at the same time the accuracy, so that the office adjustment will bring the individual stations within the set limits of error. In New South Wales, Australia, it was recommended that the length of line between city triangulation stations should be between one-half and three-quarters of a mile. In the greater New York triangulation, one station per square mile on the average was considered necessary. In the scheme herein suggested as shown in Fig. 1, it works out to about 15 stations to 13 sq. miles.

Fig. 2.

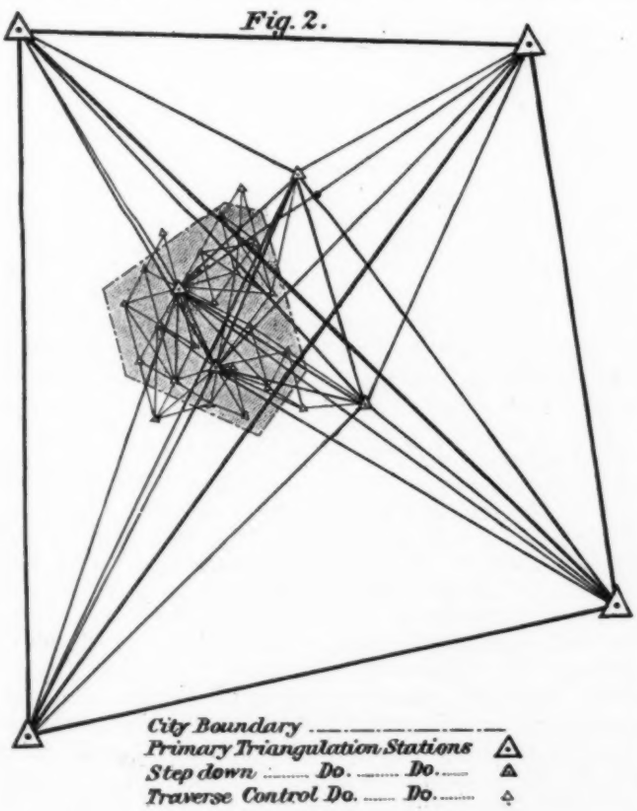
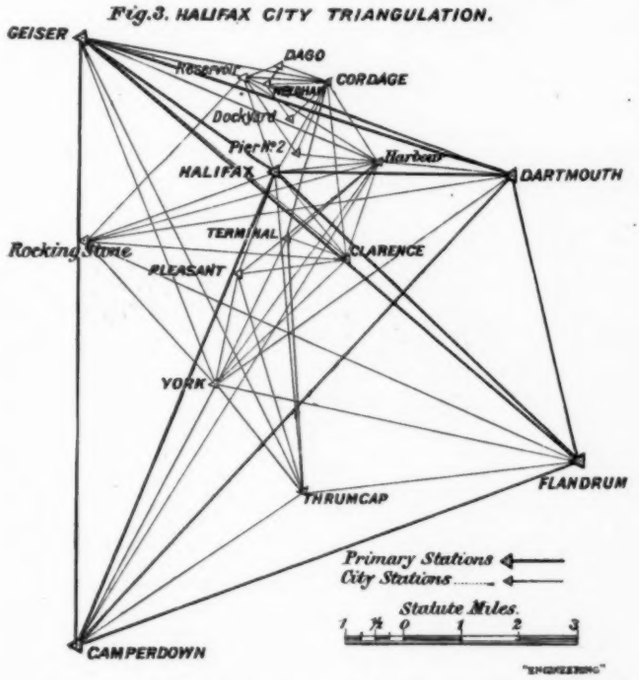
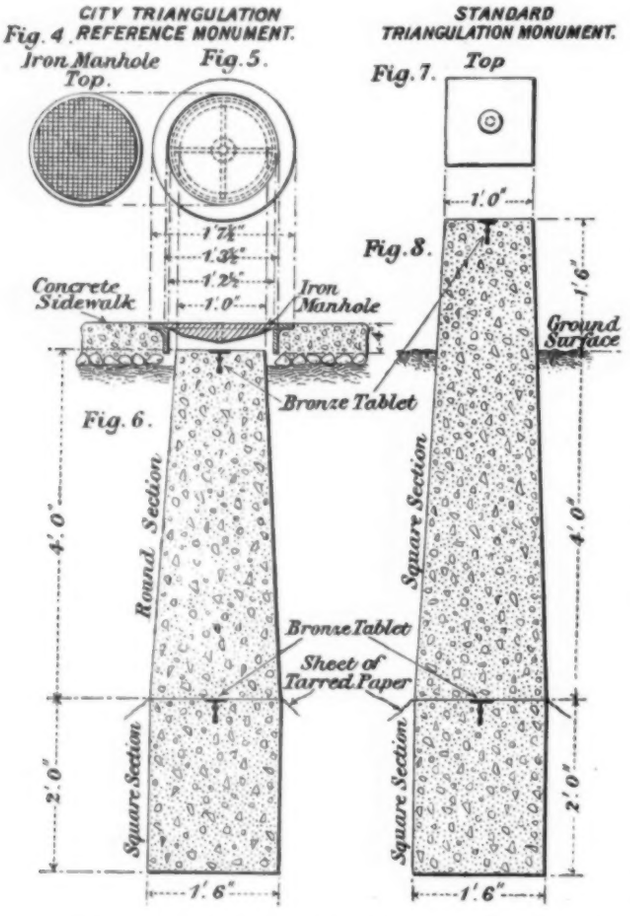


Fig.3. HALIFAX CITY TRIANGULATION.



A traverse line three-quarters of a mile in length between the triangulation traverse-control stations, under the new method of traverse survey and adjustment will hold the errors after adjustment to within the set limits, but to have triangulation stations as close as this would make the cost excessive. It is preferable, therefore, to obtain approximately the same results by a method suggested by Mr. F. P. Steers, Geodetic Engineer, in which the triangulation stations are placed a mile and a half apart, in lines three-quarters of a mile apart, every second line being stggered to bring the stations of the odd lines opposite each other, at a point opposite the midway distance between the stations of the even lines. In adjusting the traverse net to the triangulation net, there will be a traverse station midway between two triangulation stations on an east and west main traverse line which would also be a midway station on a north and

south main traverse line, as shown in Fig. 1. The position of the midway traverse station is fixed in latitude and departure by the adjustment of the co-ordinates representing the length measurements of the right-angled main traverse lines. Its position is then nearly as strong as that of a triangulation station. In this way the mile and a half lines are divided into three-quarter mile lengths, and their adjustment brings all traverse stations within the set limits of error.



City triangulation stations should be located upon the ground whenever possible, so that the traverse lines can be connected directly to them. The alternative location is on flat roofs of buildings; the lower the height of the building the more accurate will be the observing conditions and the connection from the traverse. The station point should be placed so that an instrument can be set up over it, and so that it will form one point of an approximately equilateral triangle, the other two angles being marked by traverse stations, all three being intervisible, so that all angles of the triangle may be measured. Observing towers should only be built when it is necessary to place a step-down station in a location where it will form a strong figure, since every tower built adds considerably to the cost. Complete information in regard to triangulation towers may be obtained from Geodetic Survey of Canada Publication No. 10, "Instructions for Building Triangulation Towers." Church spires, tall chimneys and flag poles, make a convenient control for small scale maps of the open country, and should be tied in from primary stations whenever possible, but they are useless for city stations as the errors made in connecting with the traverse are greater than is allowable in city work and it is not possible to obtain the bearing error from them.

The two primary triangulation stations and the line between them form the base from which the city triangulation net is started, and from which it receives its latitudes, longitudes and azimuths. Atmospheric conditions, smoke, haze, refraction, etc., encountered in observing the angles of city triangulation, together with the fact that it is not always possible to obtain as strongly conditioned triangles as desired, make it difficult to secure as accurate results as can be obtained in the open country, using the same methods and the same instruments. There should, therefore, be some kind of check, either a specially measured base line to close on, or a primary triangulation line, or, if possible, the net should be tied in on all sides to a number of triangulation stations surrounding the city.

In the United States, the city nets generally have one or more measured base lines. In the Canadian nets observed up till the present, with one exception, it has not been found necessary to measure a special city base line. This is probably accounted for by smaller primary figures near Canadian cities. Messrs. R. H. Randall and Company, of Toledo, Ohio, have kindly supplied the data in regard to triangulation closures for the first four cities below. The other seven have been taken from the data of the United States Coast and Geodetic Survey:

		Discrepancy between them.
Flint, Mich.	2 measured bases	1/24,000
Columbus, Ohio	2 measured bases	1/760,000
Pittsburgh, Penn.	11 measured bases	1/197,500
Schenectady, N. Y.	2 measured bases	1/725,000
Rochester, N. Y.	2 measured bases	1/92,000
Greater New York	2 measured bases	1/25,400
Richmond, Va.	2 measured bases	1/43,000
Atlanta, Ga.	2 measured bases	1/73,000
Atlanta, Ga.	Discrepancy between primary line and base	1/254,000
Cincinnati, Ohio	Discrepancy between primary line and base	1/53,500
Yonkers, N. Y.	Discrepancy between primary line and base	1/21,500

The above discrepancies given an idea of the closures to be expected where the net is carried across the city and closed on the other side. The Canadian nets to date, might be called double interlaced systems of triangles and are surrounded by, and based upon four or more primary triangulation stations. While such a net contains the same inaccuracies before adjustment as other nets and due to the same causes, being adjusted as a whole, it does not develop specific discrepancies, and inaccuracies are not allowed to accumulate. Such a scheme is shown in Fig. 3, the triangulation net of the City of Halifax, Nova Scotia.

The Canadian city triangulation nets, up till the present, have been developed to fix the position of such points as desired by the various city engineers, and not with regard to a definite system of traverse control. They have been used to fix the position of such objects as church spires, factory chimneys, flag poles, etc. These objects do not allow an accurate connection to be made with the city traverse system, so that the bearings can be checked as well as the latitude and departures. The system of bringing into the city net as many of the surrounding primary stations as possible is the one to be followed where stations are available, as it gives stronger conditions for adjustment. Each case, however, must be considered separately in its economic aspect. Where the cost of connecting to the surrounding stations, or to two primary stations on opposite sides of the city is too great, a base line should be measured.

Angle measurement should be made at night. The

apparatus used to make the desired stations visible to the observer, should be the automatic electrical signal lamp. Its use provides economy in operation and, to a great extent, does away with refraction errors and eliminates the phase error encountered in daylight observing. For further information in regard to signals reference may be made to the Geodetic Survey of Canada, Appendices 1, 3 and 4, of Publication No. 5, entitled *Instructions to Lightkeepers.*

Each triangulation station located on the top of a building should be referenced to a permanent concrete

SURVEY MONUMENT, CITY OF RICHMOND VA.

Fig. 9.

SURVEY MONUMENT, CITY OF VANCOUVER B.C.

Fig. 11

Fig. 12.
PLAN OF MONUMENT WITH COVER REMOVED.

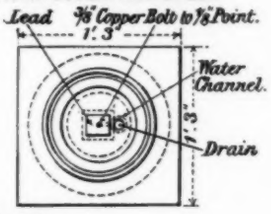


Fig. 10.

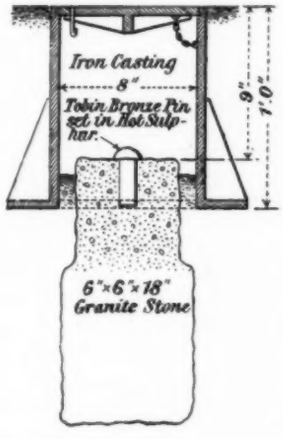
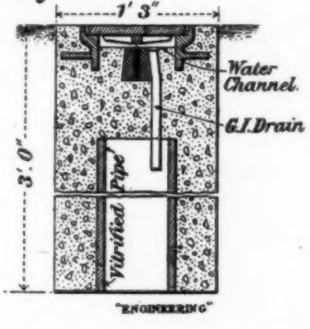


Fig. 13.



"ENGINEERING"

monument on the opposite side of the street. This monument should form one station of the triangle, which is used to connect the traverse to the control station. A suitable style of monument for a permanent reference mark is illustrated in Figs. 4, 5 and 6. The top of the monument is built as close to the bottom of the cover as possible, so that an accurate connection with the measuring tape can be made with greater facility. If loose sand is put over the top of the monument, it will tend to lessen the danger of its being disturbed by inquisitive people. These monuments should also be used as bench marks in the precise level net of the city. The design of the standard primary triangulation monument is shown in Figs. 7 and 8. Figs. 14 and 15 illustrate a suitable form of tablet to mark a triangulation station situated on the top of a building. A portion of the roof is first cleaned, then painted with high-grade roofing cement, and the tablet fixed firmly in position with three screws. If it is necessary for the tablet to be placed on stone or concrete, holes are drilled for the screws. The holes should be filled with a little neat Portland cement mixed with water. When this sets about the screws, the tablet will be made solid. Roofing cement should be painted over the edge of the tablet and adjoining roof to render it watertight. Figs. 9 and 10 show the style of permanent survey monument used by the city of Richmond, Virginia, and Figs. 11, 12 and 13 that used by Vancouver, B. C.

The measurement of city triangulation angles should be done with a primary instrument and with primary methods. In Canada, the season of the year most favorable for accurate results is during the late spring, summer and early autumn, when no fires are being used for heating purposes. Further information in regard to angle measurement may be obtained from Geodetic Survey of Canada, Publication No. 5, entitled, "Field Instructions." The adjustment of the triangulation should be carried out according to the methods developed in standard text-books on the subject. In addition

BRONZE TRIANGULATION TABLET FOR STATIONS ON BUILDINGS.

Fig. 14.

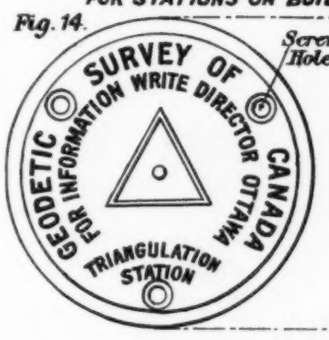
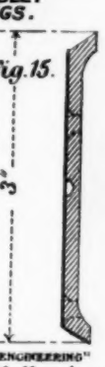


Fig. 15.



"ENGINEERING"

to these, the reader is referred to the following publications of the Geodetic Survey of Canada: Publication No. 2—*Adjustment of Geodetic Triangulation in the Provinces of Ontario and Quebec;* Publication No. 7—*Geodetic Position Evaluation;* and Publication No. 11—*Geodesy.* These publications may be obtained on application to the Director of the Geodetic Survey of Canada, Department of the Interior, Ottawa, Canada.

Acknowledgment.—Reprinted from *The Engineer* [London].

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Ohio to Build Bridges to Aid Unemployed

A large bridge building program is to be carried out this winter in Ohio as a means for providing work for the unemployed. It is proposed to develop plans and specifications during the next three months for $3,000,000 worth of bridge work to be let by the State Highway Department during the months of November and December under specifications that will require the work to be carried on through the winter months. When necessary, new construction and the workmen engaged in building it will be protected from the winter weather by crude housing or tents in such a manner that the work can go on uninterrupted except by extreme weather conditions or floods.

The selection of projects will be guided so far as possible by the recommendations of the State Relief Committee so that work will be provided in the communities where unemployment is most acute. It will obviously be impossible to finance projects in all deserving communities but best efforts will be spent in this direction within the finances available. The wages of workmen under the terms of the contracts will be governed by the minimum wage scale established for the various counties in carrying out the recently enacted minimum wage law.

The emergency program will involve the design and building of approximately 300 bridges, which is more than the usual annual bridge building program of the department.

EDITORIALS

Political Engineering

IN certain states of the union an old custom is still in vogue which should be eliminated by proper remedial legislation. I refer to the election of men as county engineers. In these states men who feel qualified to do bridge and highway engineering may have their names placed on a ballot and campaign for the office. This system is inherently unsatisfactory in that the elected engineer and the elected county commissioner both have authority as to road expenditures. Discord and inefficient management often result from this arrangement. Consequently the best interests of the county are not served.

Greater harmony and more effective operation will be secured if the board of commissioners appoint an engineer to supervise bridge and highway expenditures than if the people appoint one. When appointment is made there is a definite control of responsibility.

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"Oh, Economy, What Crimes Are Committed in Thy Name"

—Apologies to Madam Roland

OKLAHOMA'S spectacular chief executive has again made the front page. This time, however, his antics affect the engineering profession and we become interested. Summary discharge of efficient engineering executives is a blow at the engineering world in general and should receive the attention, not only of the technical press, but our engineering societies. The excuse for the wholesale discharge of state highway department engineers and executives given by Mr. Murray is that of Economy.

Last winter the governor reorganized the highway commission itself so he could hold absolute political control. This commission began to make conditions so disagreeable for Mr. A. L. Losh, then state highway engineer, that he found it desirable to accept the proffered city managership of Oklahoma City. He took this about September first. One of his former division engineers, Mr. Wilson, was named to succeed him.

About the middle of September three division headquarters were abolished, most every division engineer was fired and replaced with a resident engineer, inspector, county surveyor, or chain gang superintendent. Oklahoma City newspapers on Saturday, Sept. 19, carried stories stating that department heads in the main office had been fired. These include men who have worked up through the ranks for 10 or 15 years: such men as Burnham, Construction Engineer; James, Assistant Construction Engineer; Rightmire, Engineer of Design; and Lindsay, Engineer of Maintenance.

The excuse of "economy so the laborers may be put to work" is plainly political parsimony, not efficiency or economy. It is patently a political play for the poor man's vote; political appeasement. We may use this phrase here in perfect justification for as Andrew W. Mellon, Secretary of the Treasury says, "Just use the phrase anyway; nobody knows what it means and it will be all right." All salaries and wages are being cut 25 per cent.

This organization is entrusted with the expenditure of $17,000,000, yet practically every man who was making over $250.00 a month salary has been fired. How many successful industrial concerns or corporations spending this amount of money employ these tactics? None, for if they did they would cease to be successful concerns. Was this wholesale discharge performed for the sake of economy or as an offering to the god of politics? Economy is management without loss or waste. One small error in a program the size of that conducted for Oklahoma's road building would more than offset the four-tenths of one per cent saving in salaries that the state's chief executive thinks he is saving for his constituents. This wholesale discharge of veteran, experienced, efficient employees of the original organization of the department, has wiped out all the key men who were instrumental in building the present state highway system.

For a check on the governor's excuse we suggest that engineers watch the transactions and activities of the new political organization to see the results of such false economy.

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We Take Something for Granted

WE ARE safe in assuming that every man, woman and child of five years or more knows that a good road is better than a bad road and would rather travel over a good road than a bad one.

We therefore pledge ourselves to insult no one's intelligence with unsound arguments about why we should have good roads.

What we hope to do is to show how better roads can be obtained at a price that can afford to be paid.

With this in mind we shall try and tell what others have done, how they did it and what it cost, in such a way that you can apply it to your local conditions.

If we can help you decide what is best to do and how to do it, we have helped you. If we have helped you we have helped the cause of county road progress. That is our purpose.

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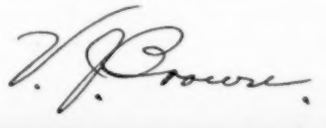
"We" or "They"

SOMETIMES we hear people speak of their county, their state, or the nation as though these larger units were outsiders and refer to the authorities as "They."

Only aliens or men who have lost their citizenship through commission of felonies rightfully refer to the state or national government as "They."

This is a "we" affair, and each of us is a citizen of several governmental units—township or town, city, county, or parish, state and nation. Each unit is composed of ourselves and others like us, and a majority of each unit eventually decides policies of government. At least, a majority of those interested enough to work at it run each unit, and every community has just about the kind of schools, roads and administration that it deserves, for, when it deserves better, it has, within itself, the power to get it.

Don't try to evade responsibility by saying "They." Say "We," and think "We" and you will soon find that this acceptance of your own obligations will help you and your community toward better conditions.



The Road Builders' News

Committeemen on A. R. B. A. Convention Program

A wide variety of subjects will be discussed by the 29th Annual Convention of the American Road Builders' Association at the Detroit meeting on Jan. 11 to 15, 1932, held in connection with the Road Show.

Organization and History.—The American Road Builders' Association was organized in 1902. The object of the Association is scientific and technical and its purpose is to acquire and disseminate information concerning highway construction, maintenance, operation and finance; to stimulate interest in good roads and to promote educational, legislative and other measures on behalf of highway development.

In the 29 years of its existence the Association has grown to be the leading organization in its field, including every interest identified with roads and streets in all countries. It represents the constructor and the operator of the highway, as well as the user. It is strictly noncommercial in character, devoting its revenue to the furtherance of the aims and objects for which it was organized. It is recognized as the leading authority on all matters relating to highway and street improvement.

To adequately carry on its educational and scientific work, the American Road Builders' Association has classified its membership, the various groups now being included in the following eight divisions:

County Highway Officials' Division
City Officials' Division
Engineers' and Officials' Division
European Division
Highway Contractors' Division
Manufacturers' Division
Membership-at-Large Division
Pan-American Division.

Numerous committees carry on the work of these divisions. The committee work includes various phases of highway and street construction, maintenance, operation and finance, as related to their particular fields. Assistance in the research and scientific studies is given by the engineering staff of the Association.

The ultimate purpose of the committee activities is the compilation and practical application of specifications, definite standards and recommended practices covering the equipment, materials and methods used in street and highway construction, maintenance, operation and finance. To this end the Association cooperates in its work with many other organizations.

The membership of the committees is composed of authorities in their respective fields of work numbering almost 1,000 leaders.

In addition to the above eight divisions, there has been created a Student

Class of membership open to students of engineering in the various colleges and universities. This membership enables the students to receive the Proceedings and various publications issued by the Association, which have been found to be of great value to them in their studies.

The Convention.—Each year the Association holds its annual convention, bringing together more than 25,000 road builders from all the states, counties and cities of the United States, as well as from many foreign countries. This attendance includes engineers, state, county and city officials, contractors, and machinery and material manufacturers and distributors, and, in addition, official delegates appointed by governors of states and the various countries in South and Central America, as well as a large number of official delegates from the several European and Asiatic countries.

At the convention the committees submit their reports covering the year's work in investigation and research, presenting the latest methods and standards, together with conclusions and recommendations. These reports are open for discussion by everyone interested. They will include reports on all problems in the construction, maintenance and operation of highways as well as problems that are of particular importance to motor freight operators. A number of the reports are being conducted in cooperation with the American Association of State Highway Officials, and one in cooperation with the Highway Research Board of the National Research Council. All of the reports are being conducted by selected chairmen and committee members who are authorities in their respective subjects. An experienced engineer—a member of the Association staff—is assigned to each committee.

At the close of the convention, the reports in summarized form are printed in the official proceedings of the association and the complete reports in bulletins, which are sent to the membership.

While committees are being continually changed and added to in order to obtain the best information available, a large number of committeemen are working at the present time. Among those engaged in Association work are the following:

City Officials' Division

Airports—Maj. D. A. Davison, assistant engineer commissioner, District of Columbia, chairman.

Design and Construction—H. L. Shaner, commissioner of public works, Winston-Salem, N. C., chairman; H. F. Clemmer, engineer of tests and materials, District of Columbia; C. H. Hawkins, superintendent of maintenance of way, St. Louis Public Service Co., St. Louis; H. C. McClure, Michigan Public Utilities Commission, Lansing, Mich.; R. H. Simpson, chief engineer, department of public works, Columbus, O., N. L. Smith, highways engineer, Baltimore, Md., Bryson Vallas, superintendent of sewerage and water board, New Orleans, La.

Maintenance—Maj. F. M. Davison, maintenance engineer, District of Columbia, chairman; R. A. MacGregor, engineer, Borough of Manhattan, New York; C. B. Bryant, engineer of materials, Maryland state roads commission, Baltimore; J. B. Early, Austin, Texas; J. McK. Spears, Highway Engineering and Contracting company, Washington, D. C., V. N. Taggett, city engineer, Niles, Mich.

Pavement Finance—A. H. Place, engineer, Detroit Bureau of Governmental Research, Detroit, chairman; A. D. Butler, city engineer, Spokane, Wash.; J. F. Hale, city engineer, Dayton, O.; W. W. Horner, chief engineer of sewers and paving, St. Louis; J. J. Jessup, city engineer, Los Angeles; D. L. Lewis, city engineer, Fort Worth, Tex.; M. S. Murray, director of public works, Kansas City, Kans.; W. E. Sheddan, city engineer, Jacksonville, Fla.; Capt. H. C. Whitehurst, engineer of highways, District of Columbia; J. M. Young, city engineer, Dallas, Tex.

Traffic—M. O. Eldridge, assistant director of traffic, District of Columbia, chairman; J. W. A. Bollong, traffic engineer, Seattle, Wash.; W. S. Canning, engineering director, Keystone Automobile Club, Philadelphia; H. C. Dickinson, Bureau of Standards, U. S. Department of Agriculture, Washington, D. C.; C. G. Gonter, traffic engineer, St. Louis; Maxwell Halsey, traffic engineer, National Bureau of Casualty and Security Underwriters, New York; E. B. Lefferts, engineer, Public Service Department, Automobile Club of Southern California, Los Angeles; Burton Marsh, traffic engineer, Philadelphia; G. A. Schuldt, presiding magistrate, police court, Washington, D. C.; Hawley Simpson, American Electric Railway Association, New York; Russell Wise, chairman, New Jersey traffic commission, Trenton.

County Highway Officials' Division

Design and Construction—C. A. Browne, chief engineer, Orange county, Orlando, Fla., chairman; C. E. Burleson, county engineer, Pinellas county, Clearwater, Fla.; G. S. Chaney, road and bridge engineer, Washington county, Washington, Pa.; P. N. Coates, county engineer, Ramsey county, St. Paul, Minn.; J. H. Dennis, county engineer, Genesee county, Flint, Mich.; Chas. W. Deterding, county engineer, Sacramento county, Sacramento, Calif.; W. E. Duckett, county engineer, Hennepin county, Minneapolis, R. R. Greene, county engineer, Lewis county, Chehalis, Wash.; E. D. Jervey, engineer, sanitary and drainage commission, Charleston, S. C.

Maintenance—H. G. Sours, county engineer, Summit county, Akron, O., chairman; J. A. Bromley, county engineer, Anne Arundel county, Annapolis, Md.; J. T. Builen, parish engineer, Caddo parish, Shreveport, La.; F. W. Denner, county engineer and surveyor, Garfield county, Enid, Okla.; E. E. Howe, county commissioner of roads and bridges, Salt Lake county, Salt Lake City, Utah; A. P. Shaw, county engineer, New Castle county, Wilmington, Del.; J. E. Walker, county engineer, Marion county, Ocala, Fla.; F. B. Wilkes, county superintendent of roads, Maury county, Columbia, Tenn.; A. M. Williams, county engineer, Ionia county, Ionia, Mich.

Legislation, Finance and Administration—W. O. Washington, county engineer, Cameron county, Brownsville, Tex., chairman; Stanley Abel, supervisor, Fourth District, Kern county, Taft, Calif.; W. W. Brandon, county commissioner, Tuscaloosa county, Tuscaloosa, Ala.; D. M. Campbell, assistant county highway engineer, Cook county, Chicago; W. M. Clark, county engineer, Osage county, Pawhuska, Okla.; E. C. Gwillim, county surveyor, Sheridan county, Sheridan, Wyo.; H. W. Keasbey, county engineer, Salem county, Salem, N. J.; B. C. McCurdy, county superintendent of highways, St. Clair county, Belleville, Ill.; H. McGraw, county engineer, Brooke county, Wellsburg, W. Va.; J. C. McLean, president, association of county engineers, Sioux City, Ia.; C. H. Overman, president, Florida state association of county commissioners, Bagdad, Fla.

Public Relations—O. S. Hess, engineer-manager, Kent county road commission, Grand Rapids, Mich.; Seth Burnley, president, county highway officials' association of Virgina, Charlottesville; C. T. Charnock, secretary, county commissioners association, Sioux Falls, S. D.; G. G. Cody, Washing state association county commissioners and county engineers, Seattle; W. M. Connelly, county commissioner, Ottawa county, Grand Haven, Mich.; R. F. Fisher, county superintendent of highways, Champaign county, Urbana, Ill.; Don Heaton, county surveyor and engineer, Benton county, Fowler, Ind.; Fred Houser, secretary-treasurer, association of county commissioners of Georgia, Atlanta; F. A. Leavitt, secretary, county commissioners and sheriffs association of Massachusetts, Brookline, Mass.; J. J. McHugh, secretary, association of boards of chosen freeholders, Jersey City, N. J.; K. I. Sawyer, secretary, Michigan association of road commissioners and engineers, Ishpeming, Mich.

Regional Surveys and Plans—E. A. Griffith, chief engineer of roads, Allegheny county, Pittsburgh, Pa., chairman; B. T. Collier, county engineer, Coahoma county, Clarksdale, Miss.; O. F. Cooley, assistant county road commissioner, Los Angeles county, Calif.; S. E. Fitch, county superintendent of highways, Chautauqua county, Jamestown, N. Y.; E. A. Gast, county surveyor, Hamilton county, Cincinnati, O.; E. L. Gates, county highway superintendent, DuPage county, Wheaton, Ill.; C. R. Haile, county engineer, Harris county, Houston, Tex.; H. F. Harris, county engineer, Mercer county, Trenton, N. J.; Roy Jablonsky, county surveyor, St. Louis county, Ill.; G. W. Jones, county superintendent of highways, Los Angeles county, Calif.; L. O. Marden, county engineer, Worcester county, Worcester, Mass.; P. C. Northrop, county engineer, Multnomah county, Portland, Ore.; N. L. Nussbaumer, Erie county, Buffalo, N. Y.; James Samson, secretary, county planning commission, Allegheny county, Pittsburgh, Pa.; L. C. Smith, county engineer, Wayne county, Detroit, Mich.; W. A. Stickel, county engineer, Essex county, Newark, N. J.; Jos. White, Allegheny county, Pittsburgh, Pa.; A. K. Vickery, county and city engineer, Denver, Colo.; G. C. Wright, county superintendent of highways, Monroe county, Rochester, N. Y.

Committees on Construction

Recent Practical Developments in Design and Construction of Low-Cost Roads—G. C. Snyder, chief engineer of maintenance, Ohio department of highways, Columbus, O., chairman; George Chaney, county engineer, Washington county, Washington, Pa.; Maj. F. M. Davison, maintenance engineer, District of Columbia; J. J. Forrer, maintenance engineer, Virginia department of highways, Richmond; E. L. Gates, county superintendent of highways, DuPage county, Wheaton, Ill.; F. H. Gilpin, asphalt sales department, The Texas Company, New York City; B. E. Gray, highway engineer, The Asphalt Institute, New York City; H. M. Kleiser, vice-president, Austin-Western Road Machinery Company, Chicago; A. E. Loder, engineer, research division, Caterpillar Tractor Company, Peoria, Ill.; George Martin, consulting engineer, General Tarvia Department, The Barrett Company, New York City; J. F. Richardson, Buffalo-Springfield Roller Company, Springfield, Ohio; K. H. Talbot, director of Research, National Equipment Corp., Milwaukee, Wis.; A. R. Taylor, Tarmac department, Koppers Products Co., Pittsburgh, Pa.

Recent Practical Developments in Design and Construction of Brick Pavements—H. G. Sours, county engineer, Summit county, Akron, O., chairman; J. S. Crandell, professor of highway engineering, University of Illinois, Urbana, Ill.; J. D. Harvey, sales manager, Southern Clay Manufacturing Company, Chattanooga, Tenn.; C. M. Hathaway, construction engineer, division of highways, Illinois department of public works and buildings, Springfield, Ill.; G. F. Schlesinger, chief engineer and managing director, National Paving Brick Manufacturers' Association, Washington, D. C.; W. E. Sheddan, city engineer, Jacksonville, Fla.

Recent Practical Developments in Design and Construction of Reinforced Concrete Pavement Bases—C. E. Foster, chief engineer, Michigan state highway department, Lansing, chairman; R. D. Bradbury, director, Wire Reinforcement Institute, Washington, D. C.; H. F. Clemmer, engineer of tests and materials, engineer department, District of Columbia; A. T. Goldbeck, director, bureau of engineering, National Crushed Stone Association, Washington, D. C.; D. B. Levi, construction engineer, Missouri state highway department, Jefferson City, Mo.; E. E. Parker, city engineer, Madison, Wis.; P. M. Tebbs, assistant chief engineer, Pennsylvania department of highways, Harrisburg, Pa.

Recent Practical Developments in Design and Construction of Asphalt Pavements—R. L. Morrison, professor of highway engineering and highway transport, University of Michigan, Ann Arbor, Mich., chairman; J. J. Davitt, John W. Davitt & Company, Jersey City, N. J.; F. E. Harris, resident engineer, New Jersey state highway commission, Trenton, N. J.; H. L. Howe, director of design and construction, department of public works, Rochester, N. Y.; Prevost Hubbard, chemical engineer, The Asphalt Institute, New York City; H. C. McClure, city engineer, Flint, Mich.; C. S. Pope, construction engineer, California highway commission, Sacramento, Calif.; H. B. Smith, county engineer, Burlington county, Mt. Holly, N. J.; J. McK. Spears, Highway Engineering & Construction Company, Washington, D. C.; H. C. Weathers, testing engineer, Florida state road department, Gainesville, Fla.

Recent Practical Developments in Design and Construction of Concrete Highways—H. F. Clemmer, engineer of tests and materials, engineer department, District of Columbia, chairman; A. A. Anderson, Portland Cement Association, Chicago; J. S. Bixby, district engineer, New York state department of public works, Poughkeepsie, N. Y.; H. E. Breed, consulting engineer, Cornwall, N. Y.; B. C. Briody, vice-president, Truscon Steel Co., Youngstown, Ohio; E. M. Fleming, manager, highways and municipal bureau, Portland Cement Association, Chicago; J. F. Hale, city engineer, Dayton, O.; R. M. Lobdell, county superintendent of highways, Lake county, Waukegan, Ill.; Clifford Older, president, Consoer, Older & Quinlan, Chicago; Riley Simrall, manager, Elastite Expansion Joint Dept., Philip Carey Co., Cincinnati, O.; W. O. Washington, county engineer, Cameron county, Brownsville, Tex.; C. M. Ziegler, deputy commissioner, Michigan state highway department, Lansing, Mich.

Committees on Equipment

Standardization of Rental Rates for State-Owned Equipment and the Establishment of the Relationship Between These Rentals and Those Recommended for Privately Owned Equipment—C. P. Owens, maintenance engineer, Missouri state highway department, Jefferson City, Mo., chairman; American Road Builders' Association: W. T. Chevalier, publishing director, civil engineering publications, McGraw-Hill Publishing Co., New York City; E. J. Harding, managing director, Associated General Contractors of America, Washington, D. C.; American Association of State Highway Officials: L. A. Fletcher, equipment engineer, Texas state highway department, Austin, Tex.; R. H. Stalnaker, equipment engineer, California highway commission, Sacramento, Calif.; Secretary—C. N. Conner, engineer-executive, American Road Builders' Association, Washington, D. C.

Committee on Equipment for Construction and Maintenance of Low-Cost Road Surfaces—J. D. Waldrop, state construction engineer, North Carolina state highway department, Raleigh, N. C., chairman; American Road Builders' Association: W. B. Greene, president, Barber-Greene Co., Aurora, Ill.; H. S. Griner, J. D. Adams Co., Indianapolis, Ind.; American Association of State Highway Officials: Ray Lindsay, maintenance engineer, Oklahoma state highway commission, Oklahoma City; Secretary—C. N. Conner, engineer-executive, American Road Builders' Association, Washington, D. C.

Bins, Batchers and Equipment for Handling and Weighing of Bulk Cement—P. M. Tebbs, assistant chief engineer,

Pennsylvania department of highways, Harrisburg, Pa., chairman; American Road Builders' Association: M. R. Butler, president, Butler Bin Co., Waukesha, Wis.; Arthur Levison, chief engineer, Blaw-Knox Co., Pitsburgh, Pa.; American Association of State Highway Officials: J. T. Ellison, chief engineer, Minnesota department of highways, St. Paul; Bert Myers, engineer of materials and tests, Iowa state highway commission, Ames, Ia.; Secretary—J. P. Cockey, assistant engineer, American Road Builders' Association, Washington, D. C.

Equipment for Spreading and Finishing Pavement Surfaces—O. L. Kipp, construction engineer, Minnesota department of highways, St. Paul, chairman; American Road Builders' Association: Lion Gardiner, president, Lakewood Engineering Co., Columbus, O.; Arthur Levison, chief engineer, Blaw-Knox Co., Pittsburgh, Pa.; American Association of State Highway Officials: C. M. Hathaway, construction engineer, division of highways, Illinois department of public works and buildings, Springfield, Ill.; C. S. Mullen, chief engineer, Virginia department of highways, Richmond; Secretary—J. P. Cockey, assistant engineer, American Road Builders' Association, Washington, D. C.

Standardization of Shoes or Rollers for Truck and Tractor Snow Plows—W. F. Rosenwald, maintenance engineer, Minnesota department of highways, St. Paul, chairman; American Road Builders' Association: George Neiss, Neiss & Co., Inc., Minneapolis, Minn.; W. D. Polk, Good Roads Machinery Co., Kennett Square, Pa.; American Association of State Highway Officials: B. C. Tiney, maintenance engineer, Michigan state highway department, Lansing; A. J. Wiggin, superintendent of maintenance, Maine state highway commission, Augusta, Me.; Secretary—A. K. Haxstun, assistant engineer, American Road Builders' Association, Washington, D. C.

Standardization of Blades for Truck Scrapers—B. C. Tiney, maintenance engineer, Michigan state highway department, Lansing, chairman; American Road Builders' Association: J. M. Rorimer, General Wheelbarrow Co., Cleveland, O.; C. J. Willett, president and general manager, Willett Manufacturing Co., Grand Rapids, Mich.; American Association of State Highway Officials: T. G. Plomasen, maintenance engineer, North Dakota state highway department, Bismarck, N. D.; A. C. Tilley, maintenance engineer, bureau of roads and bridges, Nebraska department of public works, Lincoln, Nebr.; secretary—A. K. Haxstun, assistant engineer, American Road Builders' Association.

Traffic Devices and Their Application—H. E. Neal, traffic engineer, Ohio department of highways, Columbus, O., chairman; American Road Builders' Association: G. C. Kelcey, manager, traffic engineering division, American Gas Accumulator Co., Elizabeth, N. J.; Arthur Straetz, Wallace & Tiernan Co., Newark, N. J.; American Association of State Highway Officials: A. H. Hinkle, superintendent of maintenance, Indiana state highway commission, Indianapolis, Ind.; A. W. Muir, assistant engineer, maintenance division, New Jersey state highway commission, Trenton; secretary—D. R. Lamson, assistant engineer, American Road Builders' Association, Washington, D. C.

Compaction of Earth Fills as Affected by Type and Size of Haulage and Other Equipment—F. H. Jackson, highway research board, National Research Council, Washington, D. C., chairman; A. K. Haxstun, assistant engineer, American Road Builders' Association, Washington, D. C., secretary.

Central and Truck Mixed Concrete—Col. R. K. Compton, director of public works, Richmond, Va., chairman; R. W. Cornelisen, Lakewood Engineering Co., Columbus, O.; C. B. Bryant, engineer of materials, Maryland state roads commission, Baltimore, Md.; J. E. Bushnell, Ransome Concrete Machinery Co., Dunellen, N. J.; Alexander Foster, Jr., Chas. Warner Co., Philadelphia, Pa.; R. T. Harris, Blaw-Knox Co., Philadelphia, Pa.; Capt. H. C. Whitehurst, engineer of highways, District of Columbia; H. F. Thompson, General Materials Co., St. Louis, Mo.

GENERAL COMMITTEES

Administrative and Financial Relationship of State and County—A. W. Brandt, state highway commissioner, Albany, N. Y., chairman; N. M. Blaney, director, Farm to Market Roads, American Farm Bureau Federation, Chicago, Ill.; Victor Brown, associate editor, ROADS AND STREETS, Chicago, Ill., O. W. Merrell, director, Ohio department of highways, Columbus, O.; W. O. Washington, county engineer, Cameron county, Brownsville, Tex.

Highway Location—Recent Developments in Surveying Methods and Equipment—R. G. Browning, principal locating and claim engineer, North Carolina state highway commission, Raleigh, N. C., chairman.

Report on Recent Practical Developments in Design and Construction of Low-Cost Bridges—S. B. Slack, bridge engineer, Georgia state highway board, East Point, Ga., author of report.

The Motor Freight sessions will be in charge of J. X. Galvin, as general chairman.

Recent developments in surveying methods and equipment is the subject of a report that will be presented by a committee on highway location, by R. Getty Browning.

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Motor Freight at the Road Show

Motor freight operation will be featured in a program lasting an entire day, January 12, 1932, during the 29th Annual Convention and Road Show of the American Road Builders' Association. The exhibits of trucks and motor freight accessories will be the most comprehensive ever assembled at an exposition.

The speakers on the program include: G. M. Sprowls, manager of highway transportation, Goodyear Tire and Rubber Co., Inc., Akron, Ohio, who will discuss "Vehicle Tires and Their Effect on Highways and Vehicles."

Harold S. Schertz, counsel for the Interstate Motor Carriers Association, Philadelphia, who will talk about "The Utility of the Highway."

W. O. Dilks, Philadelphia, who has the subject of "Insurance."

Tom Snyder, secretary of the Truck Association Executives of America and president of the Warehouse Distributing Corporation of America, Indianapolis.

Speakers will also discuss "Truck Taxation" and "Highways and Railroads."

All talks are limited to 20 minutes each but ample time is allowed for discussion.

Cooperation between the highway builder, the highway user and the motor freight equipment manufacturer is of vital importance. This activity furnishes an excellent medium for the various interests to assemble and discuss problems that are common to all.

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Legislation, Finance and Administration of County Roads Studied

Four interesting and valuable studies are in progress by the county highway officials' division of the American Road Builders' Association on uniform accounting, purchasing and equipment practice, specification forms, and methods of state aid extension. The studies are in charge of W. O. Washington, county engineer, Cameron county, Texas, chairman of the committee of the association.

The study of uniform accounting seeks to devise a system of accounting which may be applied to counties throughout a state. Investigation of county practices discloses that few counties have an adequate system of recording or predicting costs. Fundamental accounting principles and outlined skeleton forms, which may be extended to suit circumstances in particular counties according to their respective needs, are to be established.

Purchasing equipment practice studies will be based upon the report prepared by the association and contained in the Proceedings of 1931. This general report, prepared primarily for state highway guidance, will be reviewed and its conclusions adjusted to suit county needs. The report will incorporate suggestions in the form of an equipment purchasing code to guide and assist county officials in selecting equipment.

Specification Forms will be reviewed in an effort toward standardization of the general requirements for county specifications. Standardization of county forms with the corresponding state requirements will add to the attractiveness of county work to bidders and produce lower costs.

Methods of state aid extension will be investigated. Studies will be carried on in states where the state has full jurisdiction of all highways, where the state and county are independent of one another in their operations, and where the relations are cooperative. The advantages of the various methods will be considered. Because of the urgent and widespread demand for property tax relief, this study is most important for the advancement of county work, dealing directly as it does with the relations that should exist between states and counties in participation or distribution of highway funds.

Other members of the committee are: Stanley Abel, supervisor, Fourth District, Kern county, Taft, Calif.; W. W. Brandon, county commissioner, Tuscaloosa county, Tuscaloosa, Ala.; D. M. Campbell, assistant county highway engineer, Cook county, Chicago; W. M. Clark, county engineer, Osage county, Pawhuska, Okla.; E. C. Gwillim, county surveyor, Sheridan county, Sheridan, Wyo.; H. B. Keasbey, county engineer, Salem county, Salem, N. J.; B. C. McCurdy, county superintendent of highways, St. Clair county, Belleville, Ill.; H. McGraw, county engineer, Brooke county, Wellsburg, W. Va.; J. C. McLean, president, Association of County Engineers, Sioux City, Ia.; C. H. Overman, president, Florida state association of county commissioners, Santa Rosa county, Bagdad, Fla.

Governors Appoint Many Delegates to Road Show

Delegates to the 29th Annual Convention and Road Show of the American Road Builders' Association in Detroit, January 11-15, 1932, have been appointed by the governors of practically all the states in the country.

The state of Michigan alone has 600 special representatives of the governor appointed to attend this annual roadbuilding event. Tennessee has selected 200 to represent the governor. It is expected that several thousand personal representatives of state executives will be present.

The annual road show and convention of the American Road Builders' Association assembles 25,000 state, county and city officials, contractors, engineers, manufacturers, distributors and motor freight operators. Reports dealing with highway and street subjects will be presented by leaders in roadbuilding numbering nearly a thousand. At the road machinery and materials exhibition—the largest exhibit of heavy machinery held in the United States—road builders will inspect and compare equipment and materials. The exhibit of motor freight equipment this year is expected to attract much attention because of its completeness.

Road Builders Engineers Study Traffic Signals

To aid in settling the present lack of standardization in road and street traffic signals, a committee of the American Road Builders' Association will report on specific instances of lack of uniformity at the 29th annual convention and road show of that organization to be held in Detroit in January.

It has been found that recommended standards proposed by various organizations have not been adopted to any great extent, and there is urgent need for intensive research on the utility of various devices to the end that some degree of standardization may be attained. The organization of a research group or foundation is also recommended by the committee.

Harry E. Neal, traffic engineer, Ohio department of highways, is in charge of the committee studies.

Proper Registration of 25,000 Enormous Task

The enormous task of registering the thousands of road builders that pour into the exhibition halls of the Convention and Road Show is a tremendous task. Everyone that passes the gates must have a badge and must have completed the formalities at the registration booths.

No charge is made for admission at any convention meeting or for viewing the exhibits but complete information about every visitor—the class of road building in which he is interested and other similar details—must be given and the proper admission badge obtained.

To facilitate the speed of registration and to avoid congestion at the entrance of the exhibit halls, booths are established at the various hotels where delegates may register. At these hotel booths the visitors fill out the necessary registration cards and obtain the badges which serves to give admission to the convention and exhibition.

The badges serve another purpose than obtaining admission. Distinctive colors are used for the badges given to road builders in different specialties. One can tell at a glance what kind of work the man standing nearby does, and also his name. Many new acquaintances are made through the agency of these badges which serve to break the ice and lead to interesting friendships.

The special color schemes that are standard for road shows and conventions are: Blue, manufacturers and distributors with special insignia for exhibitors; red, contractors; yellow, county officials; green, city officials; purple, engineers and officials; pink, delegates-at-large; Canadian, Pan-American and European delegates have a white pendant seal. All members and officers of the association are given special insignia.

An information booth is maintained to aid visitors in finding people they wish to see. This necessitates the rapid compilation and classification of attendance cards so that the information may be available as soon as possible. Approximately 100 people will be engaged in this registration work at the Detroit event.

Improving Traffic Engineering

No more important problem faces the average American city than how to provide best for the travel needs of its citizens, according to M. O. Eldridge, assistant director of traffic, District of Columbia, who is chairman of the committee of the city officials' division of the American Road Builders' Association, that is studying the subject.

The United States has been transformed from a country predominantly rural to one predominantly urban. Cities are increasing in number, area and population as people are drawn by economic necessity to congregate in the vast industrial and commercial centers. In this transition the necessity for efficient and convenient transportation within and adjacent to cities has been acute.

Directors of traffic are forced to secure maximum results from the limited facilities available and certain sections of the traffic report will deal with this phase of the problem.

The interpretation of the general concept of right-of-way, the laning of traffic, safety zones, traffic control at circles and multiple intersections, and the application of a measuring stick to the needs of parking, are subjects which will be reported.

Reducing accidents and congestion by proper design and the radii of curbs at intersections will be included with the idea of eliminating in the design of future improvements the undesirable conditions which are proving a serious handicap to a smooth, uninterrupted flow of traffic.

Other members of the committee are: J. W. A. Bollong, traffic engineer, Seattle, Wash.; W. S. Canning, engineering director, Keystone Automobile Club, Philadelphia, Pa.; H. C. Dickinson, Bureau of Standards, U. S. Department of Commerce, Washington, D. C.; C. G. Gonter, traffic engineer, St. Louis, Mo.; Maxwell Halsey, traffic engineer, National Bureau of Casualty and Security Underwriters, New York City; E. B. Lefferts, engineer, Public Service Department, Automobile Club of Southern California, Los Angeles; Burton Marsh, traffic engineer, Philadelphia, Pa.; G. A. Schuldt, presiding magistrate, police court, Washington, D. C.; Hawley Simpson, American Electric Railway Association, New York City; Russell Wise, chairman, New Jersey Traffic Commission, Trenton, N. J.

Uniform street maintenance records are the subject of a cooperative study between the International City Managers' Association and the American Road Builders' Association.

It is expected that approximately two years will be required before a complete report can be made. In only a comparatively few cities are maintenance records kept in such a manner as to permit intelligent analysis of costs. This effort will develop a flexible system for such records as can be readily installed in any city regardless of the size or form of government.

County and Township Roads

Finding Unit Costs on County Roads

Accounting and record-keeping system generally applicable to county highway work can be used for planning and budgeting

By HAROLD A. STONE
Director of Research, California Taxpayers' Association

A SERIOUS problem confronted the highway department of Solano County, California, in 1928. No road cost records were kept, no accounting system worthy of the name was in use, with tht consequence that the officials had no intelligent idea which were the expensive roads to maintain or which methods were the most economical for repairs and construction. To give the country road officials the facts about the rising cost of highway work, it was decided to design a road cost accounting system.

But to devise an accounting plan which would be simple and free from the technicalities of the certified public accountant was not an easy task. The proposed plan must dovetail with existing records of the county auditor so that there would be a minimum of duplication of entries and, what appeared to be more difficult, it must not require more employees. The staff of employees could not be enlarged as this would further increase the already high tax burden. So simple must be the plan of accounting that a clerk with less than high school training could determine the costs. It was further decided that the unit costs should be obtained for each of the five road districts and should be five in number, as follows:

1. Annual maintenance cost per mile of hard or surfaced roads.
2. Annual maintenance cost per mile of soft or unsurfaced roads.
3. Annual maintenance cost per square foot of long lived bridges.
4. Annual maintenance cost per square foot of short lived bridges.
5. Annual maintenance cost per square foot of each ferry.

Such was the problem of road costs faced by the supervisors in 1928.

Physical Characteristics of the County.—Before a detailed description of the accounting plan is given, it is first necessary that the reader know the size, location, and kind of county for which this plan was made. Solano County is located in the Sacramento River Valley about 30 miles northeast of San Francisco. Its main activity is agriculture. There are five or six small communities, of which Vallejo is the largest with 14,476 people. Here is located the Mare Island Navy Yard.

The 664 miles of county roads serve a population of 40,834. It is a small county as counties go in California, with an area of 822 square miles. On a basis of density, there are about 61 persons and 792 acres to be served by each mile of road.

Most of the roads do not have a hard surface as 91.9 per cent of the mileage is dirt and gravel roads. It is estimated that 90 per cent of the mileage carries light traffic, probably not over 50 to 100 vehicles per day. The annual expenditures for roads, excluding debt service, is approximately $250,000.

Portions of the county are low and flat, making necessary more than 280 bridges over the salt marsh land. In addition, four ferries are operated by the county.

Each of the five supervisors acts in the capacity of road superintendent in his own district. The surveyor, who is elected, must be ready to advise on road matters. What little engineering work is done is usually given to him. The expenditures and financial control are recorded by the elected auditor.

The number of men employed to maintain the roads varies from a few to as many as 75, depending on the season of the year. Each of the five road districts has its own garage and storage yard. It is seldom that materials are purchased in quantities to be supplied from the yard to several different roads.

The Cost Accounting Plan.—We now come to the plan of cost accounting that was proposed for Solano County. With modifications to suit local conditions, this plan can be used in most small counties but would not be suitable for the larger ones.

The proposed plan covers two objects: (1) To record financial transactions and thereby control budget appropriations; (2) to determine costs of doing road and bridge work. In order to show both financial transactions and costs, two related sets of forms were proposed. The first gives the necessary information for the auditor's records, and the second gives cost data. The second set cannot be made except from information given in the first.

The Work of the Auditor.—The auditor is primarily interested in the first object given above, as it is one of the duties that regularly falls to his office. In addition, the records so kept will be needed in the preparation of his monthly statements showing the status of each budget appropriation, as required in the county budget law.

The auditor is not primarily interested in the second object of the proposed accounting plan, i.e., determination of road costs. However, these costs are more

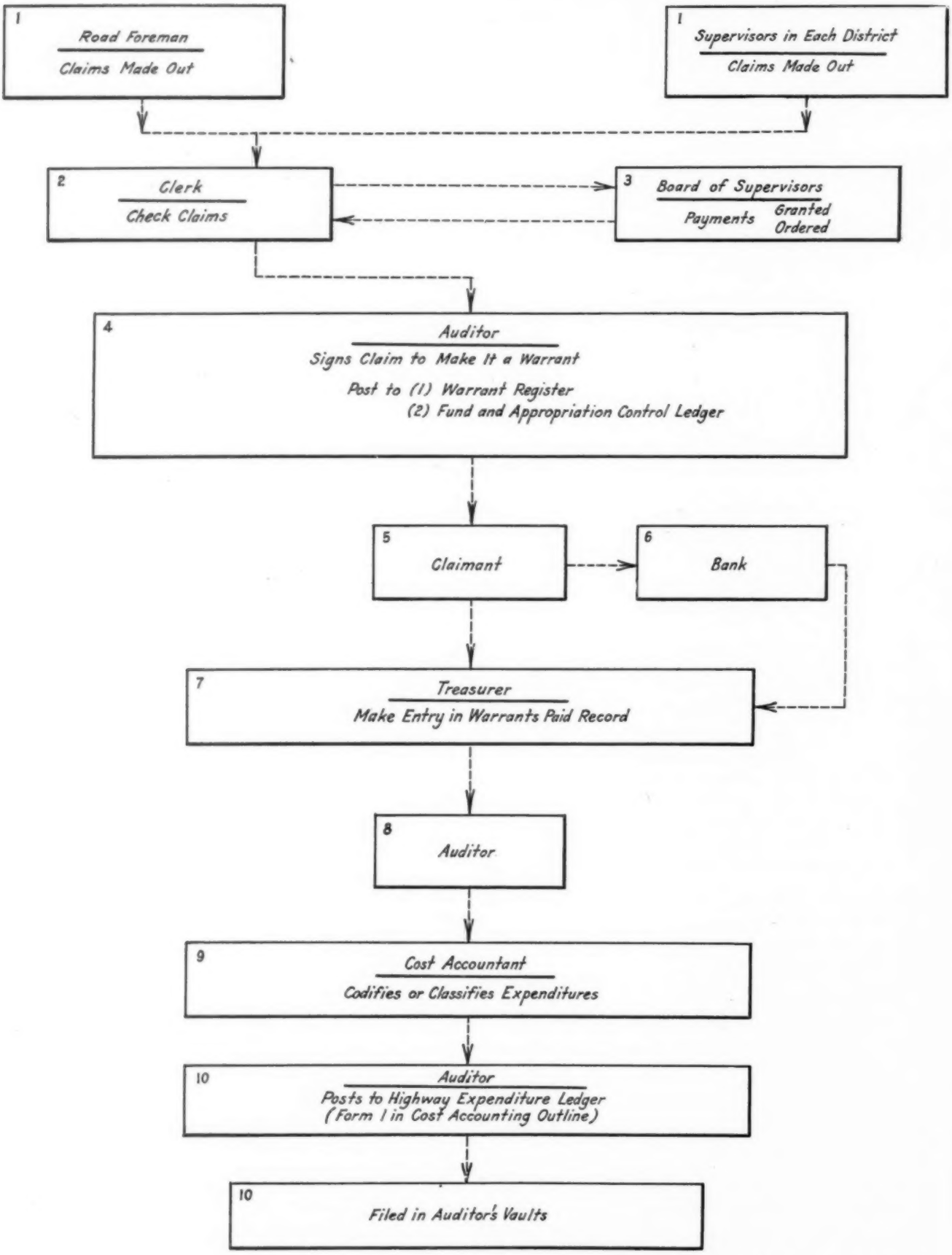


Diagram A.—Line of travel of claims and warrants for roads, bridges, and ferries for Solano County, California

readily obtained from the basic data recorded by the auditor than from any other source.

It is of prime importance that the accounting for capital outlay expenditures be completely separated from maintenance expenditures. The proposed accounting plan provides for this separation.

Codification.—The auditor should give all warrants for roads, bridges, and ferries to the cost accountant (an employee of the auditor) after they have been returned from the treasurer in Step 8, as shown in Diagram A. The cost accountant will classify them as will be explained later on. Each warrant should be previously marked by the auditor to show the fund from which it was paid. Similarly, the road district number and the number of the road for which the expenditure was made should be placed on all warrants by the person who makes out the original claim. The auditor can help by insisting that all claims show each item of this information before approving them for payment.

The warrants are ready for posting to the ledger shown in Form 1 after the cost accountant has codified or classified each of them. This form shows the type of ledger sheet needed by the auditor on which financial transactions (except capital outlay items) may be recorded and by which budgetary control may be accomplished.

The records of each road district (except for capital outlay items) will comprise three ledger sheets of Form 1, each being for a different fund. Provision is made in Form 1 to obtain monthly cumulative expenditures and balances available from each appropriation item. Each column can represent an appropriation item as given in the county budget.

Capital Outlay Expenditures.—Capital outlay expenditures are to be recorded somewhat differently than those for maintenance. If the capital expenditure is on force account, then Form 1 can be used with an appropriate title given to it. One sheet should be used for each construction project in each district. The information given will satisfy the Day Labor Publicity Law* as far as determination of costs of work done by the county is concerned.

Entries made on Form 2 for payments on contract work and on new machinery, as capital outlay expenditures, are all that will be needed. Separate books are not necessary.

The Work of the Surveyor.—The chief responsibility of the surveyor in the proposed cost accounting system is to assign a name or number to each road, bridge, and ferry. He is also to aid in the allocation or distribution of indirect expenditures found by the cost accountant. Each road and bridge should be numbered. A simple and flexible numbering scheme is one that is decimal in form, allowing for expansion as additional roads and bridges are built.

Bridge numbers can be built up in two parts, the first being the main number of the road on which the bridge is located, and the second being the number of the bridge on that road, e.g., the two bridges on road No. 70.0 can be called No. 70.0/1 and No. 70.0/2.

The Work of the Cost Accountant.—All warrants for road expenditures are to be given to the cost accountant for classifying or codifying before they are posted to the auditor's books described as Form 1. After codifying and after the auditor has posted each to Form 1, then the cost accountant is to classify and segregate further the expenditure items as found on Form 1. This last segregation is to be shown on Forms 3 and 4. Mileages of roads according to their type of surface will also be entered on these two forms, and the per mile costs obtained therefrom.

The above summary of the cost accountant's work applies to maintenance expenditures. A different set of records are to be kept for capital outlay expenditures in order that they may be completely separated from maintenance expenditures.

The monthly totals in the cost accountant's book, for each district, of all posted items should agree with the same totals in the auditor's books. The records of the auditor show the financial transactions for receipts and expenditures according to funds, whereas the books of the cost accountant are for determining costs of roads and bridges, without regard to the funds from which money was obtained.

Code Numbers.—The complete code number to be put on each claim, before posting to Form 1, is made up of three parts, each one of which is a code number in itself. The following diagram shows the items to be coded and the person who is to do each of the parts.

Code Number Made by	Item to be coded	Code Number
Foreman, Supervisor	Road, bridge, or ferry	
Cost Accountant	Expenditure Classification	
Cost Accountant	Type of road or bridge	

The workmen in the field (foremen, supervisors, etc.) should enter upon the claim the first part of a complete code number which is the number of the road or bridge where work was done or where materials were used. The cost accountant is not to do this but must be insistent that the men in the field do it. They are the only persons who have this knowledge.

Coding the Object of Expenditure.—In cost determination the cost accountant determines the second part of the complete code number according to the following object expenditure classification.

Code Number	Object of Expenditure
10	LABOR AND WAGES
20	MATERIALS AND SUPPLIES
21	Gasoline, fuel oil, lubricants
22	Road oil, asphalt, bitumen
23	Cement and lime
24	Culverts and pipe
25	Rock, gravel, sand, slag
26	Lumber
27	Miscellaneous materials (hardware, powder, water, small tools, etc.)
28	Equipment hire (take out any labor and put in No. 10)
28.1	Teams
28.2	Trucks
28.3	Equipment and machinery
30	SERVICE AND EXPENSE
31	Freight, express, mileage, transportation, demurrage
32	Rents and storage
33	Repairs and upkeep of machinery and equipment
34	Replacement of machinery and equipment
35	Damage claims, insurance (fire, theft, liability)
36	Overhead and office expense
50	CAPITAL OUTLAY
51	Force account (day labor)
52	Contract items
53	Real estate and rights of way
54	Buildings (not repairs)
55	Machinery and equipment (not replacements)

The information given on a warrant should be sufficient for determination of the classification of the

*Act 6421 of General Laws, as amended, requires that accurate costs be obtained on all new construction by day labor.

FORM 1

ALL ROAD, BRIDGE AND FERRY EXPENDITURE AND APPROPRIATION ITEMS

SOLANO COUNTY
CALIFORNIA

Fund* _____
Road District No. _____
Maintenance** _____
Month _____, 19____

Date	Items	Warrant No.	Code No.	EXPENDITURE AND APPROPRIATION ITEMS									Total Expenditures
				Salaries and Wages	Materials and Supplies					Service and Expense			
					Gasoline Fuel Oil Lubricants	Road Oil, Asphalt Bitumen	Rock Gravel Sand	Equipment Hire	Miscellaneous Supplies	Repairs to Machinery and Equipment	Replacements of Machinery and Equipment	Freight Rent, Insurance, Overhead Items, Etc.	
				Code 10	Code 21	Code 22	Code 25	Code 28	Code 23 24 26 27	Code 33	Code 34	Code 31 32 35 36	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Budget Appropriation			-	-	-	-	-	.	-	-	-	-
	Cumulative Total Expenditures to First of Month			-	-	-	-	-	-		-	-	-
	Balance Available on First of Month			-	-	-	-	-	-	-	-	-	
	Items of Expenditures during current month												
	TOTAL EXPENDITURES CURRENT MONTH			-	-	-	-	-	-	-	-	-	-

* Insert the word "General", "Road District" or "Good Roads", as the case may be.

** Insert the words "Maintenance", or "Capital Outlay by Force Account", as the case may be.

Form 1—Record for All Road, Bridge and Ferry Expenditures and Appropriate Items

expenditure. An example of applying expenditure code numbers to warrants is given as follows:

Warrant No.	Code No. Expen. Classification	Example of Items Found Upon Warrants	
100	10	2 days labor grading shoulders of road No. 65.0	$ 12.00
	10	1½ days labor repairing bridge No. No. 70.0/1	9.00
	10	2½ days labor hauling rock, road No. 120	15.00
		Total to John Doe	$ 36.00
124	21	500 gal. gasoline	80.00
128		100 tons rock @ $2.00 del.	200.00
	25	(75 tons rock $130.0-$150)	
	25	(25 tons rock $ 25.0-$ 50)	
141	27	1 doz. shovels	24.00
145		4 days truck and driver, road No. 60.0	60.00
	28.2	(truck @ $10-$40)	
	10	(driver @ $5-$20)	
153	26	200 ft. b. m. lumber, bridge 80.0/1 @ 7c	14.00
150	10	3 days surveying road No. 215 and setting stakes @ $8.00	24.00
159	10	Cost accounting clerk—salary	100.00
160		Repairs to road roller by blacksmith	
		4 bolts	$0.25
		1 bar	2.00
		3 rings	.50
		4 hrs. @ $1.50	6.00
	33	Total	8.75
170	51(23)	100 sacks cement to build new bridge No. 75.0/3 @ 90c	90.00
171	52	Third payment on contract paving road No. 185	$2,050.00

Expenditures for salaries and wages will bear Code No. 10 as shown on Warrant No. 100 above. The warrant should show the length of time and the road or bridge upon which work was done in order to apportion the expense accordingly.

Where supplies are used on more than one road, the foreman or supervisor must show the ratio for prorating the amounts to each road as shown on Warrant No. 128 above. Where possible, all labor items should be put into account No. 10 as shown on Warrant No. 145. However, outside labor to repair trucks and machinery should be charged to the same expenditure class as the item itself, just as in the case of Warrant No. 160.

Warrant No. 170, in the above example, presents a double classification arising out of a capital outlay improvement with the work being done by the county's own labor and materials (force account). Items in this account should be the exception rather than the rule, for most capital improvements will be done by contract. The costs of work done by force account should be accurately determined to compare with original bids.

The items given in the above examples may be found singly upon the warrants or may come through as a number of items upon one warrant. In the latter case, each expenditure item is to be classified so that it can be charged against the proper account.

Coding the Type of Road or Bridge.—The code number on the warrant is finally completed by adding the code for the type of road or bridge on which the expenditure was made. The purpose of this classification is to provide for segregating costs of maintaining different types of roads and bridges.

Code numbers for road types are as follows:

T10	HARD OR SURFACED ROADS
T11	Asphaltic concrete
T12	Cement concrete
T13	Oil macadam
T14	to T19 Other types of hard surfaces
T20	SOFT OR UNSURFACED ROADS
T21	Gravel
T22	Dirt
T23	to T29 Other unsurfaced types

Code numbers for bridges are as follows:

T50	LONG LIVED BRIDGES
T51	Concrete slab
T52	Concrete arch
T53	Steel truss
T54	to T59 Other types of long lived bridges
T60	SHORT LIVED BRIDGES
T61	Wood platform or plank
T62	Wood truss
T63	to T69 Other types of short lived bridges

Unit Costs.—After the three code numbers are entered on each warrant, they are then to be returned to the auditor for posting, as explained above.

When the auditor has completed posting all the warrants, then the cost accountant can make the final anal-

FORM 2.

CAPITAL OUTLAY EXPENDITURES

Solano County

Road District No.____

Date	Title and Description of Item Purchased and Name of Vendor	Fund	Cost in Dollars.

Form 2—Capital Outlay Expenditures

Form 3.

DIRECT
*ROAD MAINTENANCE COSTS
(All Funds)

SOLANO COUNTY
CALIFORNIA

Road District No. _____
Direct Costs
Type ø _____
Miles of this type ‡ _____
Year _____

Objects of Expenditures	Labor and Wages	Road Oil Asphalt and Bitumen	Rock Gravel Sand	Equipment Hire	Total Direct Cost	Indirect Cost from Form 4	Grand Total	ϕ Cost Per Mile
Code No.	10	22	25** 26**	28				
Total Monthly Direct Costs from Form 1.								
19___								
July								
August								
September								
October								
November								
December								
19___								
January								
February								
March								
April								
May								
June								
TOTALS FOR YEAR								

ø Insert the words "hard (surfaced) roads," "dirt," "gravel" or "soft (unsurfaced) roads", "long-lived or short-lived bridges", as the case may be.

* Insert the word "road", "bridge" or "ferry", as the case may be.

** If this sheet is for bridges, change item to lumber (code 26) and charge any gravel costs to Indirect Sheet, Form 4.

‡ Insert the word "area" if sheet is for bridges.

ϕ Insert the words "cost per sq. ft." if sheet is for bridges.

Form 3—Direct Road Maintenance Costs (All Funds)

ysis from the auditor's books to determine unit costs for maintenance. Further reference to the warrants should not be necessary. This final analysis can be made on Forms 3 and 4.

Costs for maintenance are to be determined in each district for groups of roads of the same type on a per mile basis, i. e., the unit costs for each type of road are to be determined. Bridge costs will be obtained on a square foot basis, as well as on a type basis.

The entries on Forms 3 and 4 are merely totals of expenditures for maintenance only, taken from Form 1, either under the same classification or under an expanded classification, as determined by the surveyor. Expenditures given in Columns 5, 7, 8, and 9 of Form 1 can be charged directly to the road or roads whereon work was done. These are direct costs and can be transferred to Form 3. On the other hand, expenditures given in Columns 6, 10, 11, 12, and 13 of Form 1 will be allocated to the various roads and bridges only with difficulty. These are indirect costs, and accurate distribution of them for any one month will hardly be possible, unless much time and thought is given to it. This, though interesting, is not necessary in a county

Form 4.

INDIRECT
ROAD MAINTENANCE COSTS
(All Funds)

SOLANO COUNTY
CALIFORNIA

Road District No. _____

Indirect Costs_____

Year_____

Objects of Expenditures	Gasoline Fuel Oil Lubricants	Miscellaneous Supplies	Repairs to Machinery and Equipment	Replacements of Machinery and Equipment	Freight Insurance Overhead Items	Total Indirect Cost
Code No.	21	23 24 25** 26** 27	33	34	31 32 35 36	
Total Monthly Indirect Costs from Form 1.						
19___						
July						
August						
September						
October						
November						
December						
19___						
January						
February						
March						
April						
May						
June						
TOTALS FOR YEAR						*

* Distribution of total cost at end of year to be transferred to Form 3, as follows:

ROADS_____ % of total. BRIDGES_____ % of total FERRIES_____ % of total.

Amount $_____ Amount $_____ Amount $_____

Hard $_____ Long-lived $_____ Ferry No. 1 $_____

Gravel $_____ Short-lived $_____ Ferry No. 2 $_____

Dirt $_____ etc.

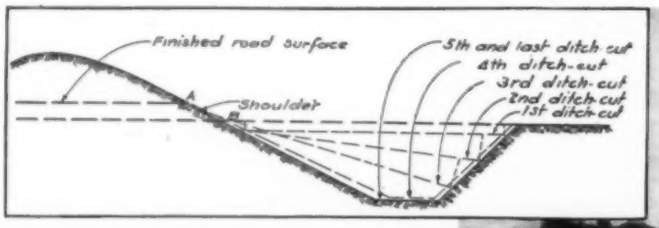
** All bridge lumber items should be charged directly to bridge account (Form 3) and any gravel (code 25) purchases for bridges should be charged to Miscellaneous Supplies on Form 4.

Form 4—Indirect Road Maintenance Costs (All Funds)

with small total expenditures. However, at the end of the year, such items should be prorated to each of the road and bridge types. This proration is necessarily arbitrary, but should be based on the best information and judgment of those who have been in close touch with the work. Form 4 has been devised to aid in recording and prorating the indirect costs. It is to be noted in using Forms 3 and 4 that they merely summarize and collect the total monthly expenditure items from Form 1. The final answers and data from Form 3 are the unit costs of maintenance work that are needed by road officials.

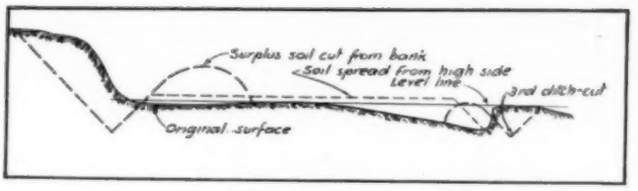
A summary of totals of all districts from Forms 2, 3, and 4 is to be made at the end of each month to determine a total for the county. The collection of summarized monthly costs will give all the necessary information for yearly costs at the end of each fiscal year.

BEFORE



This road was graded sod encroached the wheel tracks. It was necessary to roll it out where the tractor could pack it on the first ditch cut. The sketch shown herewith indicates the cuts to be made in the ditch line on the various rounds

On side hill cuts the extra earth obtained from cutting down a high bank is moved across the road by an extra round of the grader in order to raise the low side of the road. Earth cut from the ditch on the low side of the road is left at the line of the shoulder. On the return trip of this extra round the blade of the grader is reversed so that all loose earth on the high shoulder is moved toward the center of the road

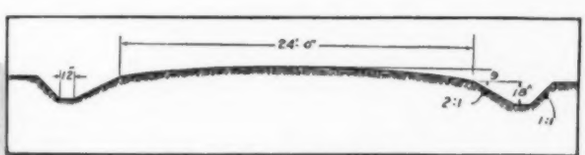


By cutting the back slope smooth and at an easy grade, the grader makes a ditch much less likely to fill than if the back slope is left rough or vertical. Besides, the smoothly cut back slope gives the road a finished appearance

This typical cross section gives one an idea of how a graded road should appear. This finished road is in Indiana where a county desired to not disturb the limestone traveled way. The pictures clearly indicate the procedure of a graded road before .....

and

AFTER



County and Local Road Improvements in 1930

A total of 35,883 miles of county and township roads were surfaced during 1930 according to the Bureau of Public Roads of the U. S. Department of Agricuture. At the end of the year the total mileage of county and local roads surfaced was 467,338.

The total surfaced mileage is composed of the following types: Sand-clay, 71,907 miles; surface treated and plain gravel, 310,308; surface treated and plain waterbound macadam, 43,527; bituminous penetration macadam, 19,059; bituminous concrete and sheet asphalt, 6,019; Portland cement concrete, 14,656; and brick and other block types, 1,862.

Counties and other local authorities outside of cities expended a total of approximately $700,000,000 for road purposes divided as follows: Construction $297,000,000, maintenance $284,000,000, miscellaneous $37,000,000 and interest on bonds $82,000,000. The local authorities also expended $113,000,000 for bond retirements and transferred $39,000,000 to the States for State road work.

The mileage of surfaced local roads and the mileage surfaced in 1930 appear in the accompanying table:

State	Mileage of local road surfaced in 1930	Total mileage of existing surfaced local roads	Total mileage of all existing local roads
Alabama	1,143	16,196	62,381
Arizona	215	1,976	20,185
Arkansas	75	2,018	60,039
California	1,899	21,165	70,375
Colorado	278	3,213	59,740
Connecticut	19	1,573	12,022
Delaware	50	441	2,962
Florida	102	11,601	23,703
Georgia	129	11,006	95,160
Idaho	523	7,007	35,260
Illinois	920	15,112	87,398
Indiana	806	46,048	67,657
Iowa	1,853	13,552	95,643
Kansas	906	2,787	123,550
Kentucky	509	9,500	46,261
Louisiana	100	4,654	25,044
Maine	415	4,341	18,843
Maryland	146	3,055	11,594
Massachusetts	493	8,058	17,178
Michigan	1,152	18,724	72,997
Minnesota	3,697	30,423	103,770
Mississippi	1,846	12,613	55,856
Missouri	781	8,688	102,094
Montana	100	2,024	58,924
Nebraska	508	1,602	84,155
Nevada	485	703	19,802
New Hampshire	132	626	9,486
New Jersey	743	7,601	15,520
New Mexico	.....	343	38,442
New York	1,901	23,034	68,360
North Carolina	1,712	14,226	45,091
North Dakota	82	843	99,445
Ohio	2,241	39,582	73,763
Oklahoma	120	1,966	114,484
Oregon	75	10,327	47,265
Pennsylvania	1,287	17,586	77,366
Rhode Island	92	521	1,730
South Carolina	1,266	13,936	51,733
South Dakota	757	3,112	114,295
Tennessee	2,183	12,058	60,909
Texas	500	15,616	169,836
Utah	100	2,547	20,219
Vermont	25	1,523	10,827
Virginia	190	6,979	52,269
Washington	155	14,023	40,633
West Virginia	387	2,205	30,635
Wisconsin	2,784	20,267	71,563
Wyoming	1	337	38,106
Total	35,883	467,338	2,684,570

Cost of Farm Terracing

Soil erosion, which annually causes enormous losses to the farmers, can be effectively controlled by terracing. A bulletin (No. 1669) issued recently by the U. S. Department of Agriculture, contains the following on the cost of building the terraces.

Several variable factors affect the cost of constructing terraces. Some of these are, nature and condition of the soil, length of the terraces, vegetal covering, kinds of implements used, methods employed, and the skill and experience of the operator and the vigor with which he pushes the work. In some instances constructing terraces in wet soil may easily cost twice as much as in dry soil. More time and labor are required to build a terrace in a heavy clay than in a sandy loam soil. Short terraces cost more per running foot than long terraces, owing to the time lost in more frequently turning the equipment at the ends. A heavy covering of long grass or weeds usually interferes with terrace building and retards the progress of the work. Roots, rocks, sprouts, and stumps add materially to the difficulty of construction and in many cases make the cost of terracing prohibitive. The costs of constructing the same terraces by two experienced operators might easily vary as much as 50 per cent because of differences in skill. Farmers ordinarily do not have sufficient terracing work to do on their own farms to make them proficient in this work, and until an operator gains sufficient experience the cost of constructing terraces is appreciably greater than that for which he might do the same work later. To these several factors and to the fact that very little reliable cost data have been collected may be attributed the great differences of opinion among farmers and engineers with regard to the cost of terracing.

Where conditions are ideal for terracing work as regards type and condition of soil, uniformity of slope, freedom from stumps, roots and rocks, and absence of gullies or depressions so that no scraper work is required, a terrace 15 in. high, 20 ft. wide, and not less than 1,000 ft. long can be built on slopes of up to 6 or 8 ft. in 100 ft. at a cost of about $20 per mile or $1.50 per acre. The cost will range from the foregoing to as high as $180 per mile or $15 per acre where a field is badly cut up with many deep gullies. Table I may be taken as a general guide to the cost of building terraces of the dimensions given above, in light soils. For heavy soils, about 50 ct. per acre should be added to the costs given in the table. The cost per acre will also increase on steeper land and for shorter terraces. Variations from the above costs will also occur on account of inexperience, poor equipment, and wet soil.

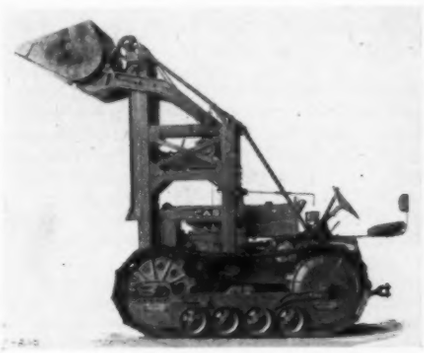
TABLE I—APPROXIMATE COSTS[1] OF CONSTRUCTING TERRACES 15 INCHES HIGH, 20 FEET WIDE, AND NOT LESS THAN 1,000 FEET LONG, IN LIGHT SOILS ON MODERATE LAND SLOPES

Description of land	Cost per acre	Remarks
Clean-cultivated land, no gullies	$1.50-$ 2.50	
Grass or virgin land, no gullies	2.00- 3.00	
Clean-cultivated land, small shallow gullies	3.00- 6.00	Depending upon the number of gullies.
Clean-cultivated land, gullies 3 to to 6 feet deep	7.00- 15.00	Depending upon the number of gullies.
Newly cleared land, no gullies, most stumps grubbed out	7.00- 12.00	Depending upon the kind and number of roots and stumps.

New Equipment and Materials

Trackson High Shovel Now on Case Tractor

The Trackson Company, Milwaukee, Wis., announces that its high shovel is now adapted to the Case-Trackson heavy-duty crawler tractor. This unit is designed so that the bucket is held close to the tractor to insure positive digging action and proper balance and the mechanism that actuates the shovel is at the front of the tractor.

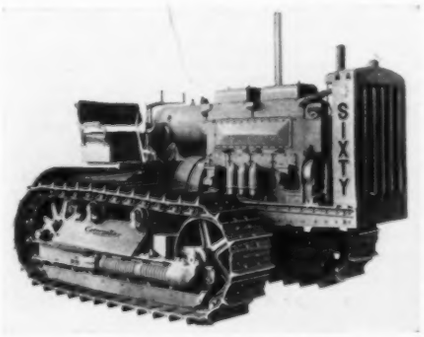


Trackson High Shovel Mounted on a Case-Trackson Crawler Tractor

The bucket is controlled by a single lever, raising in 10 seconds and lowering in 5, and has a lifting capacity of 3000 lb. The shovel unit in no way interferes with the drawbar operation of the tractor.

Caterpillar Diesel Tractor

Following several years of experiment, development and tests, the Caterpillar Tractor Co., Peoria, Ill., has brought out a tractor powered by a diesel engine. "Caterpillar"-designed, "Caterpillar"-built, the diesel engine has been developed as a power plant for the Sixty tractor. Power, traction, transmission, frame—all are coordinated in correct balance. In accomplishing this, certain changes in the design of various parts other than the engine have also been made. Frame side members of the Diesel Sixty differ from the Standard Sixty. Radiator design is modified. A heavy equalizer spring is used instead of an equalizer bar. Tracks are of 34 sections; recoil springs are tandem type.



New Caterpillar Diesel Sixty

In the "Caterpillar" Diesel Sixty the fuel injection apparatus is Bosch equipment, adapted to "Caterpillar" requirements. An important contribution by Caterpillar Tractor Co. in the building of this engine and its presentation to the public is the introduction of sealed fuel injection apparatus. Supplied with each tractor is an extra set of fuel pumps and nozzles—adjusted, sealed and interchangeable as units—avoiding any necessity for field adjustments to the fuel injection system. Should a fuel pump or nozzle ever require adjustment in the field one of these units may be quickly substituted and the troublesome one returned to the Caterpillar Tractor Co. for servicing.

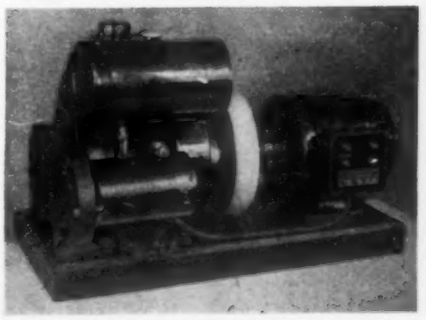
The "Caterpillar" Diesel Sixty tractor develops 63 maximum drawbar horsepower and 75 maximum belt horsepower. Its shipping weight is approximately 25,000 lb.

The "Caterpillar" Diesel engine is started by a small two-cylinder "Caterpillar" engine, compactly mounted on the left side of the main power unit. The starting engine is cranked by an easily accessible crank—it operates on gasoline or other high-volatility fuel—connection to the main power plant is automatically disengaged when operating speed is reached. The "Caterpillar" Diesel engine uses any oil commonly merchandised as Diesel oil, normally sold in the United States.

The "Caterpillar" Diesel Sixty tractor is the only Diesel-powered model in the "Caterpillar" line—it is an addition to the line and does not displace the standard Sixty, powered by gas engine.

Portable Electric Plant

A small sized generating plant producing 110 volt, 60 cycle alternating current has been brought out by the Kato Engineering Co., Mankato, Minn. The plants are made in four different capacities, from 350 watts to 2000 watts. These units consist of an air-cooled gasoline engine connected direct to a 110 volt, 60 cycle alternating current generator. The speed is kept approximately the same between no load and full load by a very sensitive governor.



Kato Plant No. 2 with Electric Starter

The plants are designed to work equally well for stationary or portable installation. The unit is ruggedly built, and yet it is compact and small in size and requires a very small space for installation. The engines are 4 cycle air-cooled and there is no water to freeze when the plants are left unattended. No storage battery is necessary except on the self-starting model, where a 6-volt battery is furnished for starting the engine.

New Sand and Gravel Spreader

A new sand and gravel spreader which places the material ahead of both the spreader and the truck has been placed on the market by the Universal Road Machinery Co., Kingston, N. Y. The spreader consists of a short and long conveyor, together with a revolving disc working in unison. The short conveyor is pivoted at the foot of the long conveyor and can swing out to permit the loaded dump truck to be attached, after which it swings back of and is attached to the rear of the truck chassis. At the head of the long conveyor is an adjustable chute which carries the material down to a circular distributor with selective speeds. This selective speed distributor provides adjustments to meet different conditions of material and coverage such as fine, coarse, wet or dry, distance, etc.

The spreader has its own independent power unit which operates the spreading mechanism as well as the two belt conveyors, three gear ratios being provided so that any desired coverage can be obtained. Motive power is supplied by any standard dump truck, which is simply attached or detached through a coupling pin provided for the purpose.

The Reliance Sand and Gravel Spreader

The amount of material applied to the square yard, the width and depth of spread and the direction of travel are all under the operator's control from a seat conveniently located at head end where he can observe closely the work it is doing. Spreads a heavy cover 8 to 12 ft., or will sand any width up to 30 ft.

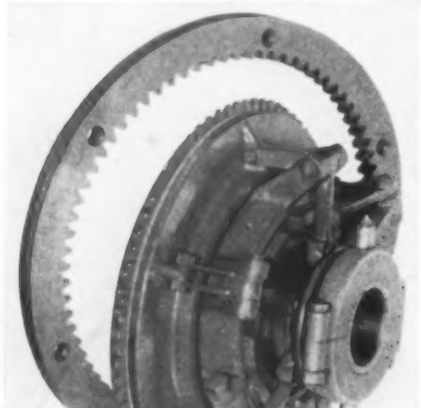
The spreader can be operated with any standard dump truck, simply coupling the truck to the spreader by means of a pin provided for this purpose. With the body of the truck elevated to dumping position, the material is delivered to the short cross conveyor, passes to the long conveyor and thence to the distributor already described. When empty the truck can be uncoupled and a loaded unit attached in two minutes time.

This new patented unit is equipped with anti-friction bearings throughout and when not operating can be hauled from place to place at ordinary truck speed. It is stated to be equally serviceable for sanding icy hills or turns in winter, building sand and gravel roads or covering oil in summer.

While capacity depends largely on type of coverage required, the spreader will, it is stated, handle up to 60 tons per hour. When spreading heavy cover, it operates at 5 to 6 miles per hour; when sanding at 10 to 15 miles per hour. It is stated that it will spread a 5-ton load in about three minutes.

New Heavy-Duty Twin Disc Clutch

In certain heavy-duty installations it is necessary to take into consideration the effect of centrifugal force on the clamping member. This condition will occur for instance, when the clutch proper is the driving member and therefore rotates continuously during the time the mechanism is in use, whether the driving member



New Type CR Twin Disc Clutch

is being operated or not. When used in this manner, the operating mechanism of usual construction will tend to extend radially outwards, similar to the flyballs of a governor, and this will tend to partially perform the operation of closing the clutch, thereby causing drag of the clutch plates, and consequent wear.

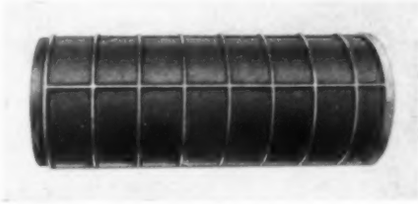
To overcome this, the Twin Disc Clutch Co., Racine, Wis., has designed the new type CR clutch. Centrifugal force will cause the inner ends of the levers to fly outwards and this in turn will apply tension to the toggle links, which are connected to the clamping plate. It follows therefore that the greater the action of centrifugal force, the greater will be the pull tending to draw the clamping plate away from the friction discs, or driving plate.

It will be further noted that when the clutch is being operated to engage it, the initial movement of the clamping plate will be comparatively fast, but as it reaches its closed position it slows down, due to the straightening of the toggle links which now exert their maximum pressure. Provision is made to carry the links over center, and the inner ends of the levers are also moved beyond the true radial line, in order to ensure a locked engaged position.

This clutch while originally designed for heavy work in the oil fields is adapted to any type of heavy-duty equipment such as locomotives, cranes, shovels, etc.

Cast Iron Culvert Pipe

A cast iron culvert pipe manufactured by the Alabama Pipe Co., Anniston, Ala., is illustrated below. This pipe has a locking joint of 4-lug design. It locks



Section of Atlas Cast Iron Culvert Pipe

by turning either to the right or to the left, assuring, it is stated, a tight joint with perfect alignment. The 12 in., 15 in., 18 in. sizes are made in 4 ft. lengths, the 24 in., 30 in. and 36 in. sizes in 3 ft.

Line of 32 Ft. of 18 In. Atlas Cast Iron Culvert Pipe

lengths. The metal thickness for the 12 in. size is ¼ in., for the 36 in. size it is ⅜ in. The 12 in. size weighs 40 lb. per foot and the 36 in., 200 lb. per foot. The ribbed construction of the outside of the pipe barrel makes possible a combination of maximum strength and minimum weight, according to the manufacturer. The pipe has a smooth bore providing maximum flow with minimum friction. The castings are heated to 300° F. and dipped in a bath of coal tar pitch varnish. Uniform metal thickness, length and weight, is stated is to be assured by the patented process of mechanical molding.

New Sand Spreader

A new spreader has been brought out by the Anderson Engineering Sales Co., Statler Bldg., Boston, Mass. This ma-

Anderson Sand Spreader

chine has two rotors, one being at the extreme left and the other in the middle. Together with these are interesting feeding arrangements, and facilities for a continuous and uniform flow of material which can be varied in quantity at a moment's time.

The rotors and feeders are mounted integrally on a special tail gate which is furnished by the manufacturer to fit any standard type of dump truck. The whole unit replaces a regular tail gate. Very effective driving power is taken from the V between the pressed steel wheels where duals are used, or from an easily bolted-on sheave if the truck has single tires.

The spreader unit is attached or detached in less than five minutes after the first installation. The simple operation of changing means little more than detaching the truck tail gate and setting this in its place. When installed, the side chains, connected by means of ordinary grab-links, hold the tail gate vertical, and therefore the rotors are in the desired horizontal position for proper spreading, regardless of the angle at which the truck body is inclined. The material to be spread is then moved by gravity to and through the special tail gate which has a suitable hole to permit the sand to flow to the appended hopper. The use of this small hopper is to allow sand to move onto two positively driven screw feeders which not only feed the material very evenly, but will break up frozen sand.

Directly below these feeders are sliding gates by which the amount of the flow is regulated to any desired quantity. Through these gates the sand is spouted to the rotors. Two rotors are incorporated in the design. Through this arrangement sand can be spread in the middle of the road while the truck is being operated on the right hand side at a speed that will not impede other traffic. Many state highway departments prefer to spread in this manner and for this method only the left hand rotor is employed. For others who wish to spread full width over a wide road, both rotors are used and the truck operated more nearly in the middle of the highway.

This spreader is made to handle dry, or damp, screened or run-of-bank sand. By the use of a suitable grating, no oversize stones reach the road through the rotors. The operation of the spreader is controlled by a clutch which is within easy reach of the operator's platform, or it can be manipulated from the truck cab if desired.

New General Motors Truck

Suitable for a wide variety of purposes and industries, a new low-priced truck in the 1½ to 2-ton range, powered with a 6-cylinder 60-hp. motor, and priced at from $595 to $665 has just been announced by the General Motors Truck Co. at Pon-

tiac. The new truck is known as the T-18.

Nine and 12-ft. body lengths are made possible in this new truck through use of two wheelbases, 131 and 157 in., while dual wheels are offered as optional equipment. On the 157-in. base they are provided at no extra cost, while on the 131-in. base they are installed at only $25 additional.

A complete line of bodies are offered, including platform, stake, panel, open express, canopy top express and screen express in either single or two unit types, stock rack, panel-van and high express, all finished in the deep Murat green with Venetian yellow striping, the color combination that has proved so popular with the General Motors truck line. Twelve optional colors are offered at no additional cost if desired.

Motive power is provided by the sturdy G. M. T. 200 engine, which has proved its qualities in several other G. M. T. models. This is a 6-cylinder, 60 hp., L-head type motor, made vibrationless through use of a heavy crankshaft which is not only dynamically and statically balanced, but counterweighted and equipped with a harmonic torsional balancer.

Protection against freezing is assured by the highly efficient flat tube and fin type radiator as in this type should freezing occur the tubes expand into cylindrical form instead of bursting.

The truck has a turning radius of 22 ft. 9 in. for the 131-in. wheelbase and 28 ft. 3 in. for the 157-in. base. Extra strength is imparted to the sturdy frame through use of stress absorbers, while the long semi-elliptic springs assure excellent riding qualities.

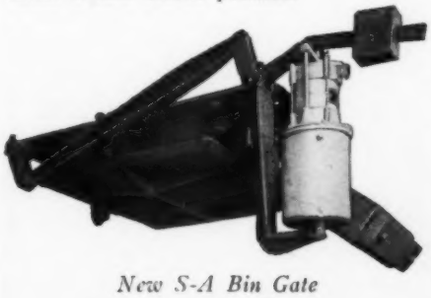
New Bin Gate with Remote Control

A new automatic dump gate that can be opened and closed by electric push release switch has been developed by the Stephens-Adamson Mfg. Co. of Aurora, Ill.

The gate was designed primarily for emptying batch weigh hoppers in S-A ready mixed concrete plants, but can be used wherever the entire load in a bin or hopper is to be dumped by remote control.

The gate consists of a throat casting, a counterweighted valve plate to close the opening and two latch mechanisms operated by a General Electric "Thrustor." The valve plate is held closed by the front latch. Upon pressing the operating button, the Thrustor opens the latch and with the weight of the load opens the valve.

The valve plate remains open until the operating button is again pushed, when the rear latch is opened by the Thrustor and the counterweight on the valve casting forces it up until the front latch locks it into closed position.



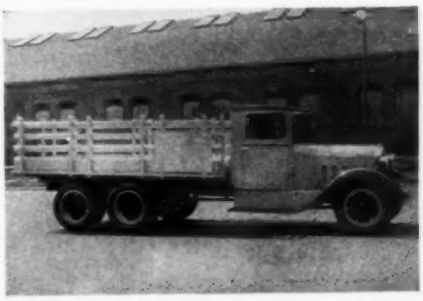
New S-A Bin Gate

New Federal Truck

Following the introduction of its single drive 3-ton 6-wheeler over a year ago, the Federal Motor Truck Co., Detroit, Mich., has brought out a dual drive 6-wheeler, with 6-wheel hydraulic brakes, of the same capacity, available in 4 and 6-cylinder engines at $1350 and $1450 respectively, for standard chassis f.o.b. Detroit. The 4-cylinder model is supplied in 140-in. and 164-in. wheelbases. The 6-cylinder chassis in 145-in. and 169-in. wheelbases. Aside from the dual drive feature, this new Federal is basically the same as the single drive 6-wheeler. It is built by Federal as a complete transportation unit, with the dual drive 6-wheel feature designed and engineered into the chassis as an integral part of the vehicle. Many exclusive and patented features are claimed for this truck.

The dual drive for this new Federal was developed by Federal engineers. Among the important patented Federal features of this model are the spring suspension and reservoir method of lubricating trunnion pins. Power is applied to the four rear wheels through two bevel drive full-floating rear axles with oversize differentials and driving gears.

Unusual tire economy is said to be accomplished by the unique arrangement of the spring suspension. There are two bearings on each side—one above and one



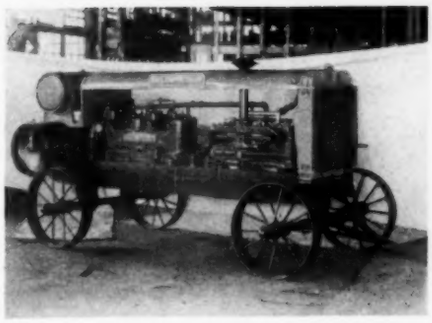
New Federal Dual Drive Truck

below the axles attached at the center to forked bearing brackets mounted on a short trunnion shaft supported from the frame side rail.

The upper spring on one side is shackled at the forward end, while the lower spring is shackled at the rear. With this construction, there is provided not only considerable flexibility in the tandem unit, but there is also a natural tendency for the axles or wheels to "track" each other when rounding curves. The same pronounced ease of riding and load-cushioning properties of the single drive Federal are incorporated in this model.

New 240 Ft. Compressor

A new 240 ft. compressor of the 4-cylinder type has been added to the line of the O. K. Clutch & Machinery Co., Columbia, Pa. All parts of the new product are interchangeable with the company's 2-cylinder 120 ft. compressor with the exception of the crankshaft and cylinder block. The new compressor is equipped with a Hercules power unit, 6-cylinder Model YXC3, direct connected to the compressor. The outfit is comparatively light in weight and strong and is



New 240 Ft. Compressor

stated to have been tested and proven an efficiency of 75 per cent.

The crankshafts are made of the highest grade of steel as well as the connecting rods. The crankshafts are equipped with balance weights which are integral with shafts and are one solid drop forging and there is no chance to come off as in the older types. The bearings are unusually long. This 4-cylinder machine has three bearing crankshafts with bearings 5½ in. long with force feed lubrication. The cylinders are oiled by splash system. The oil pump is of the positive eccentric cam and strap type. The pistons are made of the special metal and fitted with three compression rings and one oil vent ring. The bearings throughout are of the babbitted bronze back shell type and are inter-changeable. The water jacket on the cylinder is very large and extends to the bottom of the cylinder. In order to keep the compressor the coolest part of the outfit, the water is pumped into the compressor first, from there to the engine and then to the radiator. The valves are of the caged duo plate type and ground joint seated in the cylinder head. The compressor is also equipped with the latest type of Penn unloader and the engine is equipped with a carburetor air throttling device which idles the engine during the period of the compressor being unloaded and also speeds up the engine before the compressor is loaded again.

New Feature Added to Insley Shoulder Finisher

With the development of a new shoulder specification in Indiana including what is called "metal shoulders" a development has been made on the Insley shoulder finisher to take care of the requirements of this specification. This type of shoulder requires the excavation of a trench along the edge of the pavement 6 in. deep, 6 in. wide at the bottom and 18 in. wide at the top, which trench is filled with crushed stone or gravel. This provides a shoulder close to the slab of such material that a motor car can safely run off the edge of the slab without becoming mired down or endangered.

To meet this specification the Insley shoulder finisher is built with an extra blade attached to the inner end of the main blade. When the main blade is set at the proper angle this extra blade scoops out a trench of exactly the required dimensions, a job which would otherwise have to be done by hand.

This is one of many unique features

of the Insley shoulder finisher, others of which include a slope blade which can be racked in or out and the angle of which can be changed to meet any angle of back slope. Another feature is the guide bar which runs along the edge of the concrete slab and takes the side draft imposed on the machine by a heavy blade full of dirt and also automatically fixes the dimensions from the edge of the slab to the edge of the shoulder.

A leveling device is furnished on the main blade and when once properly set gives the correct elevation of the outer edge of the shoulder in relation to the slab without the necessity of grade stakes being furnished by the project engineer.

DeVilbiss Announces Highway Striping Outfit

A highway striping outfit, which is used for spray-painting a traffic line stripe on public highways and city streets has just been perfected by The DeVilbiss Company, Toledo, Ohio, manufacturers of spray-painting and spray-finishing equipment.

DeVilbiss Highway Striper

The DeVilbiss highway striping outfit, Type HS, illustrated in the accompanying photograph, has been developed to meet all conditions of such character. This outfit lays a perfect stripe at a speed of from six to eight miles an hour. It stripes in a few hours the distance that can be painted by hand in a day, and removes the danger to men in hand striping. About seven gallons of paint is used for each mile of striping, depending upon the kind of material used, thickness of coating desired, and the surface of the pavement.

The Type-HS outfit can be attached to either right or left running board or can be used as a trailer from the rear of a truck. While it is substantially built for its purpose, yet it is light enough for one-man handling in loading and unloading and attaching to truck. A special toggle type joint with spring tension frees the striping outfit from truck jars. Road jars are absorbed by the rubber tires on the equipment.

The running board stripes type is fastened to the truck by a clamping arrangement which also holds the horizontal draw bar in position, as illustrated. The design of the equipment permits of adjustment for various heights of running boards. The operation of the striper does not obstruct traffic. In intermittent striping, or in going from one job to another, the outfit can be lifted by chain or rope from the operator's position on the truck, thus permitting the driving of the truck at greater speed between jobs.

The trailer type striper is similar to the running board type, except that it has a vertical draw bar and bracket with clamping arrangement to clamp the draw bar at various heights, as illustrated. The bracket is bolted to the truck floor. The bracket adjustment permits of fastening and holding the striper in a level position on trucks of different heights.

The automatic spray gun is mounted on an arm between two metal discs. These discs insure a uniform stripe, and are adjustable from a four-inch to a six-inch width. The spray gun arm can be swung in a horizontal position or taken out if necessary for adjustment or cleaning of spray gun. The discs are kept free from paint accumulation by a set of self adjusting scrapers. The excess paint is deposited in the drip pan, and can be strained and used again in the paint tank, or for hand painting at intersections.

Drive-On Loadometer Developed

The Black & Decker Mfg. Co., Towson, Md., has just announced an improved design of their Drive-On Loadometer for measuring the loaded weight of all trucks, trailers, buses and tractors. It is used principally in the enforcement of existing weight laws governing the use of motor vehicles on highways and streets.

Two cams support the platform and hold it above the mechanism until the wheel comes to rest on the platform. This method of controlling the wheel load insures accuracy by preventing transmission of wheel impact or thrust to the recording mechanism. Further, the inclined ramps of the new "Turtle-Back" type Loadometer are an integral part of the weighing platform, thereby making it possible to accommodate the large balloon tires now being used on many motor vehicles. In this connection, it is pointed out that the large platform (11 in. by 20⅝ in.) will easily accommodate the largest balloon tire (13.50 in. by 24 in.) as well as any size of solid tire.

The Loadometer is made of a heat-treated aluminum alloy, giving maximum strength with minimum weight. The complete outfit consists of two Turtle-Back Drive-On Loadometers packed in a handy carrying case. They are furnished in load capacities of 7,000 lb., 15,000 lb., 20,000 lb., 3,500 kgs., 7,000 kgs., and 7 long tons.

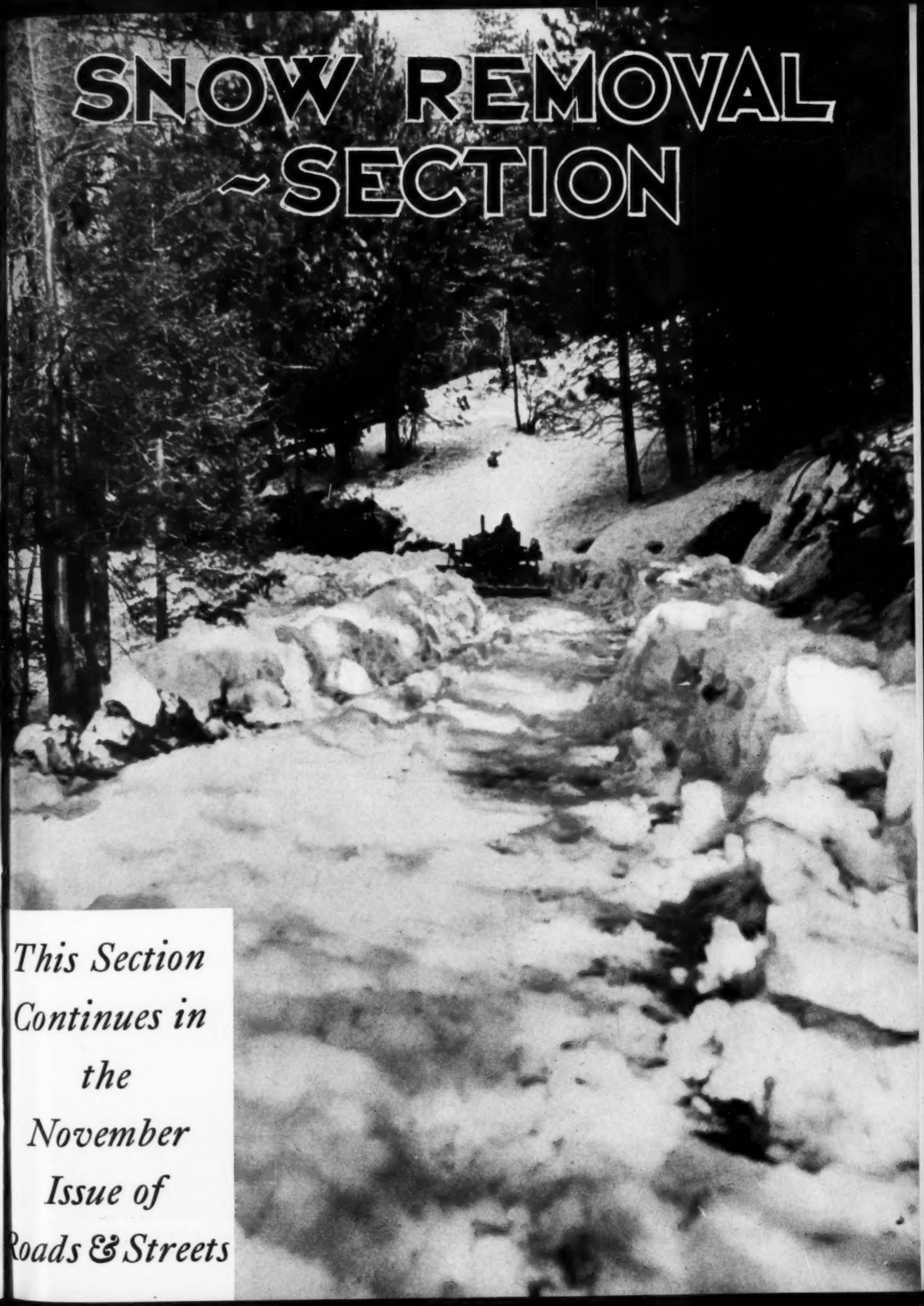
Loadmaster Equipped with 20-In. Electro Magnet

The Loadmaster, manufactured by Bucyrus-Erie Co., South Milwaukee, Wis. and mounted on either wheels or crawlers, may now be obtained equipped with 20 in. Ohio magnet. This magnet equipment makes the machine a very useful tool for handling scrap iron and small castings which ordinarily require considerable time for hooking. The Loadmaster require no more space for operation than a small automobile, has a full-revolving boom and can be used as a tractor, as a crane or can lift and travel with its load. Power is supplied to the magnet by a 2 K.W. Kohler electric plant, mounted on the truck frame of the crane.

Black & Decker Loadometer

Bucyrus-Erie Loadmaster

SNOW REMOVAL SECTION



This Section Continues in the November Issue of Roads & Streets

Motor Grader Equipped with Plow Heads Into a Drift on Highway in Cook County, Illinois

By W. J. O'NEIL
Cook County Highway Department

Vigilance and Organization
Effect Rapid Snow Removal

TWO years ago an unprecedented snow fall in the Chicago area completely tied up traffic for several days. Like everyone else the county highway department was not prepared for a storm of that magnitude and with great difficulty opened the county roads to traffic.

Immediately following the storm the highway department laid its plans for future snow removal. Previously they owned no equipment and had hired private parties to clear the highways.

Equipment amounting to some $10,000 to $12,000 was purchased, consisting of 4 motor graders equipped with snow plows and blades and 6 large crawler type tractor snow plows. The motor graders are fast in

Showing V Plow Breaking Through and Bulldozer Blade Plow Following Behind Removing Windrows

Snow Fencing Time Is Here!

HIGHWAYS must be kept open at all times. And—one of the biggest factors in the carrying out of this work is snow fencing. In connection with snow fencing posts are needed. Steel Posts are strong, sturdy, last many years and are easy to erect.

Ideal U Posts With Tongues for Snow Fencing

The tongues are spaced 10 inches apart—5 to a post—one for each of the five cables in Snow Fencing. Tongues are long, heavy, strong and rigid but can be bent if desired.

Ideal U Steel Posts can be conveniently placed between the slats in Snow Fencing. The cables cross the flat back of the post behind the tongues and are held firmly.

Posts are painted after punching with a Willow Green steel paint baked on under high temperature.

Anchors can be furnished when wanted. The closely spaced lugs on face of posts not only add strength, but make a secure resting place for tie wires when desired.

Write to us for additional information

Furnished in 6-ft., 6½-ft., 7-ft., 7½-ft. and 8-ft. lengths in four weights or specifications as follows—

A, 2.60 lbs. per ft.
B, 2.00 lbs. per ft.
C, 1.80 lbs. per ft.
D, 1.329 lbs. per ft.

Ideal U Snow Fence Posts, without anchors, pack nicely as illustrated, making a conveniently handled bundle

1831 COMMEMORATING AMERICAN STEEL & WIRE COMPANY 100 YEARS of PROGRESS IN WIRE MAKING 1931

AMERICAN STEEL & WIRE COMPANY

208 South La Salle Street, Chicago SUBSIDIARY OF UNITED STATES STEEL CORPORATION And All Principal Cities

Pacific Coast Distributors: Columbia Steel Company, Russ Building, San Francisco *Export Distributors:* United States Steel Products Company, New York

A New Principle in Snow Removal

WHAT USERS SAY—

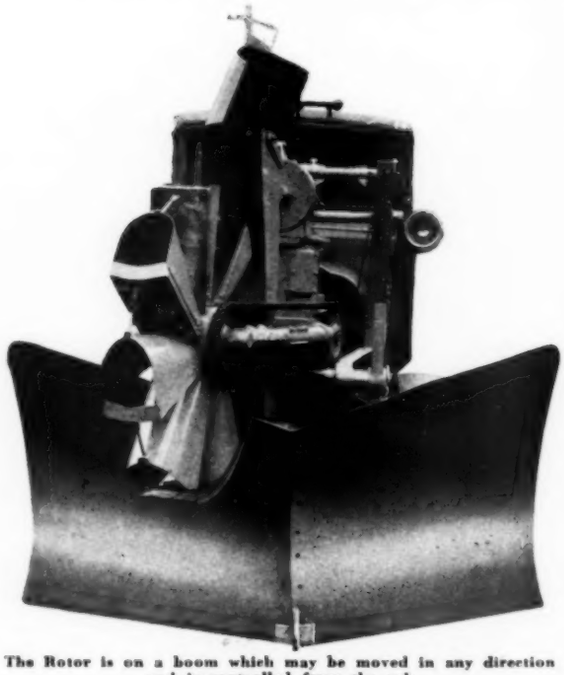
WISCONSIN—"The snow was exceptionally hard and heavy and resisted all efforts to move it with moldboard plows. Your shovel threw this snow clear from the roadway. The shovel handled over 25 cubic yards, or approximately 7 tons of snow per minute. Under the worst conditions your rotary shovel could dig its way through."

IDAHO—"In many cases if we had not had the rotary auxiliary we would have stalled due to encountering drifts that the V-plow would not handle. I do not know of a better piece of equipment."

CALIFORNIA—"Two Rightway shovels were used this spring in opening up some of the passes across the Sierra Nevadas. Some of the drifts were 20 feet or more high on the bank side and the snow was very heavy in some places with considerable ice in it."

COLORADO—"Tried out plow at ten thousand feet elevation yesterday in drifted, frozen snow—the worst possible conditions—on an eight per cent grade. The shovel moved steadily through drift after drift."

MICHIGAN—"One of the worst storms ever witnessed visited this district and it was only due to the efficient work of these shovels that we managed to keep our highways open for wheel traffic. These shovels worked continuously, night and day, throughout the entire week, stopping only long enough to be greased and oiled or to make minor repairs. We like these shovels very much and from our experience with them we believe they are the new thing in snow removal work."



The Rotor is on a boom which may be moved in any direction and is controlled from the cab

NEW YORK—"A stretch of road, approximately 6 miles in length, which was blocked to traffic by snow 6 ft. to 8 ft. deep, over which a sleigh road had been maintained, was opened up by the Rightway combination plow and rotor and the surplus snow was completely disposed of."

PROVINCE OF QUEBEC—"The ideal snow plow for highways is one combining the advantages of both the rotary and the V plow. The advantage of this is that when there is no more than 2 feet of snow on the road, the truck is allowed to make speed, using only the V plow, and, when a snow bank is encountered, it is only necessary to throw the blower into gear." . . . Quebec has purchased three Rightway rotaries and V plows.

Rightway Shovel disposing of banks rolled up by moldboard plows

QUIT BUCKING!

The severe strains resulting are usually responsible for breakdowns and delays when the equipment is most needed, not to mention the expense of service and replacements.

Trucks equipped with Rightways are relieved of these bucking strains because operators are never tempted to smash through when it is easy to shovel the deep drifts out of the way.

Cook County Preparedness Won Public Approval and Permitted Business to Continue While Illinois State Outfits Were Still Fighting Primary Road Drifts

operation and for snows up to 12 and 15 inches can quickly open a traffic lane. They can operate in deeper snows but are not as economic as the heavy tractor plow. The crawler tractor plow is a slow moving mechanism but with unlimited power and will force a way through drifts 4 and 5 feet deep with ease.

Organization was perfected with Mr. Charles Case in charge. Every man was given a definite station and assigned to a particular equipment and location. Periodic inspection of material and personnel was made with an intent to be so organized that no storm could tie up the highways any length of time.

Month after month of the winter slipped by and spring arrived with no storms of any severity whatever. Naturally relaxation set in with weather turning warm. When on March 7th and 8th a terrific blizzard found the department somewhat surprised, the results of previous training and preparation proved themselves with prompt action. The snow began on Saturday and continued without a letup until early Monday morning. The roads were completely blocked by Sunday morning. Only 50 to 60 per cent of the milk trucks were getting through.

All but two of the county plows were functioning early Sunday morning. One being repaired was in service Sunday afternoon and the other was operating

Illustrating How Bulldozer or Blade Plow Continues to Widen Plowed Area with Each Succeeding Trip

Monday afternoon. The roads were opened Sunday but drifted full in a short time. The county plows continued to reopen the roads as fast as they drifted shut and by Wednesday night every main traffic artery was open to the public.

The state and municipality roads were still blocked. At one point a drift 3½ ft. deep and approximately 700 ft. long could not be opened up by one of the state's plows mounted on a heavy truck. It was necessary for one of the county's motor graders to get through that drift in order to proceed to a road it was supposed to open, and in spite of the failure of the big state plow to negotiate it the small motor grader opened this stretch to traffic.

Thursday every main road and side road in the county were open to traffic. The foresight of the maintenance department in purchasing the snow equipment and the vigilance maintained in the organization had resulted in the fastest reopening of highways in Chicagoland's history.

Greater preparations are being made for the coming winter and the public can rest assured that roads will be opened promptly and kept open. Four additional motor graders and over 25,000 ft. of snow fence have been purchased the past year and will be utilized in future snow removal programs.

Effective snow removal demands the use of three different types of equipment. A mobile, fast operating truck mounted equipment for light snows; a slower, intermediate type of equipment for average deep snows;

Illustrating How Road Is Left After Machine Has Finished Its Work

and a slow, powerful crawler tread type of equipment for excessive storms and blizzards.

The Cook County (Illinois) Highway Department is equipped with the intermediate and slow powerful types of equipment. The maintenance department is authorized to rent the fast moving, mobile type of equipment whenever the conditions warrant so doing.

What happens when roads are not kept clear of snow. Drivers cannot control movements of vehicles traveling at rapid rates when they encounter drifts. Scene south of Chicago

A Moment's Rest Before Hitting the Drifts Again

Secondary Road Snow Removal *in Union County, Iowa*

By ARTHUR K. OLSEN
County Engineer

SECONDARY road snow removal is of rather recent origin in this section of Iowa. Prior to 1929 very little effort was made to open anything but primary roads due primarily to lack of sufficient equipment. The local roads which were opened at that time were shoveled out by hand, a slow and expensive process.

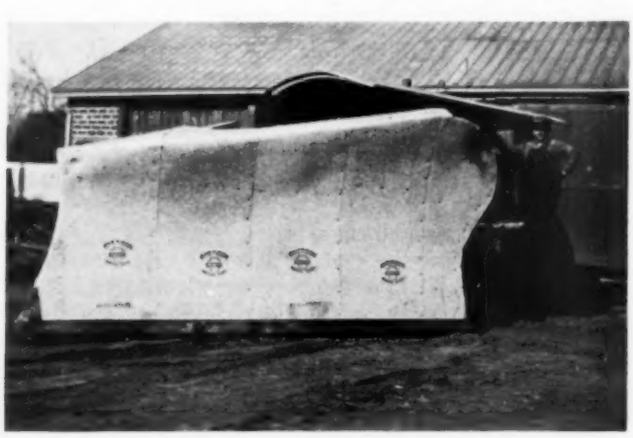
On Jan. 1, 1930, however, when the Boards of Supervisors were given the supervision of all except primary roads in the county a beginning was made toward systematic snow removal.

Under the best of conditions snow removal is very expensive, even with equipment built for the job, and this is the limiting factor when a plan for taking care of blocked roads is being worked out, particularly for secondary roads. Fortunately we are not in the heavy snow belt, but even at that we usually have one or two storms which close everything for a time.

In order to keep within our means it is necessary for us to adapt our summer maintenance equipment for snow removal. Thus we depend entirely on crawler tractors when at times a 4-wheel drive truck would be a great deal more satisfactory, since a truck plow can cover four or five times the ground a tractor can when conditions are not too bad.

In the winter of 1930 we purchased a Wausau plow with mechanical lift wings for use on a 60 Caterpillar as shown in the pictures. This makes a very effective snow weapon for heavy drifts, it will go through any thing we have here. We ran it night and day until the battle was over. It was, of course, impossible to cover our entire mileage of 750 miles, but we did open

Light Weight Plow Made by the County in Its Own Shops



Side View of Home Made Snow Plow

the main roads and as many of the others as possible.

The chief trouble with this outfit lies in the heavy weight. The tractor and plow weigh 17 tons which, while ideal for fighting heavy drifts, makes it impossible to cross a great many bridges which simply will not carry the load. Since most of the bridges are in the eastern half of the county we are forced to leave this heavy outfit in the western section where there are but few such structures.

This has made it necessary to develop suitable equipment for use where the bridges will not stand the large plow. Our experience with drifts taught us that the first requisite for snow equipment is power and traction. For effective snow removal with crawler tractors nothing with less power than a 60 hp. machine is to be considered. Neighboring counties tried 30 Caterpillars with factory built plows on account of their lower weight, but they were not satisfactory. We use two other 60 hp. tractors besides the one on which we mount the heavy steel plow during the grading season, so in the fall of 1930 for these we built two wooden plows covered with sheet iron as shown in the photographs. These were built for about $300 each, are strong enough to do the job but do not add over one ton to the weight of the tractor, making it possible for us to cross practically any bridge. They were completely built in our own maintenance shop.

This Equipment Is Too Heavy for the Bridges of the County

Last year we had but one opportunity to use these plows, and that did not come until late in March, when a heavy, wet snow fell. It was a hard snow to remove and the wooden plows had a tendency to rise, due to the compact nature of the snow, even the heavy steel plow was riding on top part of the time. Fortunately this type of snow is rather rare, for that which falls during the cold months is dry. With a frozen road to work on, in the cold months, traction is better.

With these three plows working on a strict schedule 24 hours a day, we intend keeping as many of our roads open as possible. Of course, we realize that this is hardly adequate equipment to open our entire system up in 24 or 48 hours, but we at least can keep main arteries and mail routes from becoming blocked. It is financially impossible for us to buy enough equipment to take care of 750 miles of secondary road in the same manner as the primary system is taken care of but, by adapting what equipment we have, we can give the public very much better secondary road snow removal than they had four or five years ago.

Snow removal is very popular with the public, and as much of it must be done as finances will permit. Unless vigilance is exercised, however, it is very easy to cripple the maintenance fund seriously for the entire year. There is no question but that it pays to get the snow off the roads as soon as possible for the benefit of the surface itself. A road which has been kept clear of snow during the winter never breaks up as bad in the spring as one on which the snow has been allowed to alternately thaw and freeze. We, therefore, contemplate keeping as much of the system clean as possible, but we rather hope the snow will not be heavy this year.

▼

County Believes in Preparedness

By J. W. MAVITY
County Engineer, Harvey County, Kansas

Harvey County, Kansas, does not have many snows during the year, but these snows are accompanied by high winds. Wheat being the principal crop, the wind has an unobstructed sweep across these fields carrying the snow with it and piling it in the roads.

This condition makes it imperative that the county be supplied with a certain amount of snow removal equipment, even though it be used very few times during the year. This county has three tractor plows for the purpose of keeping its 133 miles of county roads open; a V-type La Plant-Choate hydraulic plow mounted on a 30 Caterpillar tractor, a V-type hand control Good Roads plow mounted on a 60 Caterpillar tractor, and a V-type Baker hydraulic plow mounted on a 75 Monarch tractor.

Whenever the roads block, these three units, which are equipped with lights, are operated continuously until the roads are opened. They are equipped with wings in addition to the V-part, so that one trip through the

Bucking a Deep Drift in Harvey County, Kansas

road opens wide enough to allow a lane of traffic in both directions. After the roads are all opened, the drifts are then all pushed off for the full width of the roadbed.

In addition to this heavy equipment, the county has three Adams motor patrols which are used in lighter snows.

The whole county system is usually opened for traffic within twenty-four hours after becoming blocked.

The county also uses preventive measures to keep the roads free from drifts, some 12 miles of snow fence being used for this purpose. The fence used is a four foot picket fence, placed about 75 ft. back of the property line. Steel posts are used. The fence is erected in the fall and taken up again in the spring, so as to not interfere with farm operations.

On all new grading the county is elevating the roadbed about one foot above the adjoining fields in order to prevent drifting.

Keeping Highways Open Through One Hundred Inches of Snowfall

The various types of equipment that were used in Berkshire County, Massachusetts, are discussed and conclusions regarding most effective methods are drawn

By G. N. WILLIS

Senior Civil Engineer, Massachusetts Department of Public Works

IN western Massachusetts, the winter of 1930-31 produced the heaviest snowfall experienced since the State Department of Public Works undertook the task of clearing the roads and keeping them safe for winter travel.

The snowfall amounted to about 90 in. at Pittsfield where district headquarters are located and was well over 100 in. on the surrounding hills. It was a noteworthy and unusual fact that there was very little high wind during February when a very large amount of loose, light snow lay on the ground. Had our usual northwest gales blown, great difficulty would have been encountered in keeping roads open. One or two northeast gales blew and these caused trouble because snow fence was set for the prevailing northwest winds.

In Massachusetts, snow removal equipment, excepting only light trucks, used on maintenance work, is used only for snow removal purposes and is not used during the summer months. While from some viewpoints, this would indicate an economic waste, it insures all equipment being in first class condition at the beginning of winter as all machinery is thoroughly reconditioned at a state operated garage machine shop during the summer months.

Light plows with 8-ft. blades were used for the first time last winter on fast 1½-ton trucks. They proved to be very efficient and economical for cleaning up light falls of snow and would usually take care of the first cut through in heavier storms. Trucks were always worked in pairs usually with one of the small ones ahead near the center of the road followed at a distance of about 200 ft. by a heavier piece of equipment.

These heavier units were mostly of a type that drove on all four wheels and carried 10-ft. blade plows. A number of hydraulically operated V-plows mounted on trucks were also used. These were equipped with a 10-ft. wing on the right side. The V-type is not efficient for state highway work because usually so heavy a piece of equipment is used only for widening after blade plows have cleared the center and thus only one-half of the V is used and much snow spills around the point and so makes extensive "mopping up" necessary.

A number of heavy (10-ton) tractors with V-type hydraulic plows and a hydraulic wing on the right side were stationed at strategic points for use on the heaviest work. While these were at times necessary, their extreme slowness and consequent limited cruising radius makes them very inefficient and uneconomical. They also represent a large investment and cost much to operate.

A Rotary Hitting a Badly Drifted Road

Work Here for Most Powerful Type of Equipment

Wherever there is a through cut there will come a time, if snow continues to fall or to drift, when no further plowing can be done by any push plow however powerful because the snow becomes packed to a consistency closely approximating solid ice and no further compression is possible. It then becomes necessary to remove some of the packed snow in order to make room for more. This may be done manually or mechanically. The first is too slow for any great amount of work. A good rotary plow is the best equipment. This should be truck mounted to facilitate

POSITIVE TRACTION

Makes FWD Truck a big favorite FOR SNOW REMOVAL WORK

Keeps Highways open at Lowest Cost

The FWD is just a good, powerful, economical *sure-footed* truck, different in principle . . . and when equipped with a good snow plow, you have a winning combination that will keep your roads open at the lowest costs.

That's why the majority of State, County and Township Highway Departments in the "Snow Belt" use FWDs in large fleets . . . they know that the FWD is exceptionally powerful . . . it puts all of the power developed to actual use . . . it drives and brakes on all four wheels . . . it pushes through those heavy drifts.

This booklet gives you the FACTS. Write for it!

The advantages of the FWD Truck are embodied in a booklet, "Written on Snow Removal". Write today for your copy, Dept. A.

THE FOUR WHEEL DRIVE AUTO CO.
Clintonville, Wisconsin
Canadian Factory: Kitchener, Ontario

FWD

BACKED BY NATION-WIDE SERVICE

its moving rapidly from place to place. A chute for delivering the snow with the wind is essential otherwise the operator cannot see where he is going and also the snow interferes with the operation of the motor. A rotary plow was tried out a little during the past winter

Rear View of a 10-Ton Tractor with Sargent Hydraulic Plow and Wing Widening Through Becket Center

but was not very successful. In one case a gasoline shovel was used to remove packed snow from a cut. If much work were to be done with a power shovel, a special large bucket should be used.

While the cost of snow removal is an extremely variable thing due to the varying texture of snow, velocity of wind, and duration of gale, the following will give an idea of the cost during a winter when the snowfall was somewhat above average and the wind velocity below average. In keeping costs, expenditures

Deep Snow at Summit of Mohawk Trail Road Open but Banks Not Pushed Back

were separated under several headings. The heading that included charges directly connected with snow removal included plowing, shovelling, and snow fence. Under this head was included all operating, storage, and repair costs but not original cost or summer reconditioning expenditures. A charge per hour for state owned equipment was included varying according to size of machine. The cost for the year amounted to $3.62 per inch of snowfall per mile.

The cost of sanding including sand and calcium chloride amounted to $125.00 per mile. The use of calcium chloride mixed in the sand in the proportion of 1 to 7 proved worth while as it cut the ice and held the sand on the road on very cold days when plain sand would skid off. The cost of opening waterways through snow banks amounted to $33.00 per mile. It

The Finished Job at Summit of Mohawk Trail. Bank on Right Is Fourteen Feet High

A Rotary Plow Failed to Open This Packed Drift. It Was Necessary to Loosen It by Hand Labor

Gas Shovel Widening a Cut Where Snow Was Too Compact to Be Compressed Any More With Push Plows

was found that a large fall of snow costs less per inch to move than a small one and that wind increased the cost several hundred per cent at times.

5 FEET DEEP—

AND IT PLOWS RIGHT THRU

Big drifts hold no terrors for LaPlant-Choate Hydraulic Snow Plows. The real worth of snow removal equipment is measured by its ability to get thru where snow is thickest.

Thousands of dollars were spent in your vicinity last year to build new roads and maintain old ones. What is the use of all this expense if those same roads are stopped by snow during the winter months? Why spend money for summer maintenance if winter traffic is allowed to cut the roads to pieces? From every angle snow removal is worth while. LaPlant-Choate Plows will save your money and save your roads.

WRITE FOR OUR LATEST CATALOG.

LA PLANT-CHOATE
MANUFACTURING CO. INC.
CEDAR RAPIDS, IOWA, U. S. A.

Breaking Snow Blockade on U. S. Highway 83 Between Minot and Bismarck

SNOW TRAPS

Avoided By Correct Design and Location

By RAYMOND A. PEASE

Division Engineer
North Dakota Highway Department

THE problem of winter maintenance in North Dakota resolves itself almost entirely into that of keeping the roads from becoming blocked with snowdrifts. The ground is frozen from early November to the first part of April and only occasional trips over the surface with patrols are necessary to insure from fair to good riding surfaces.

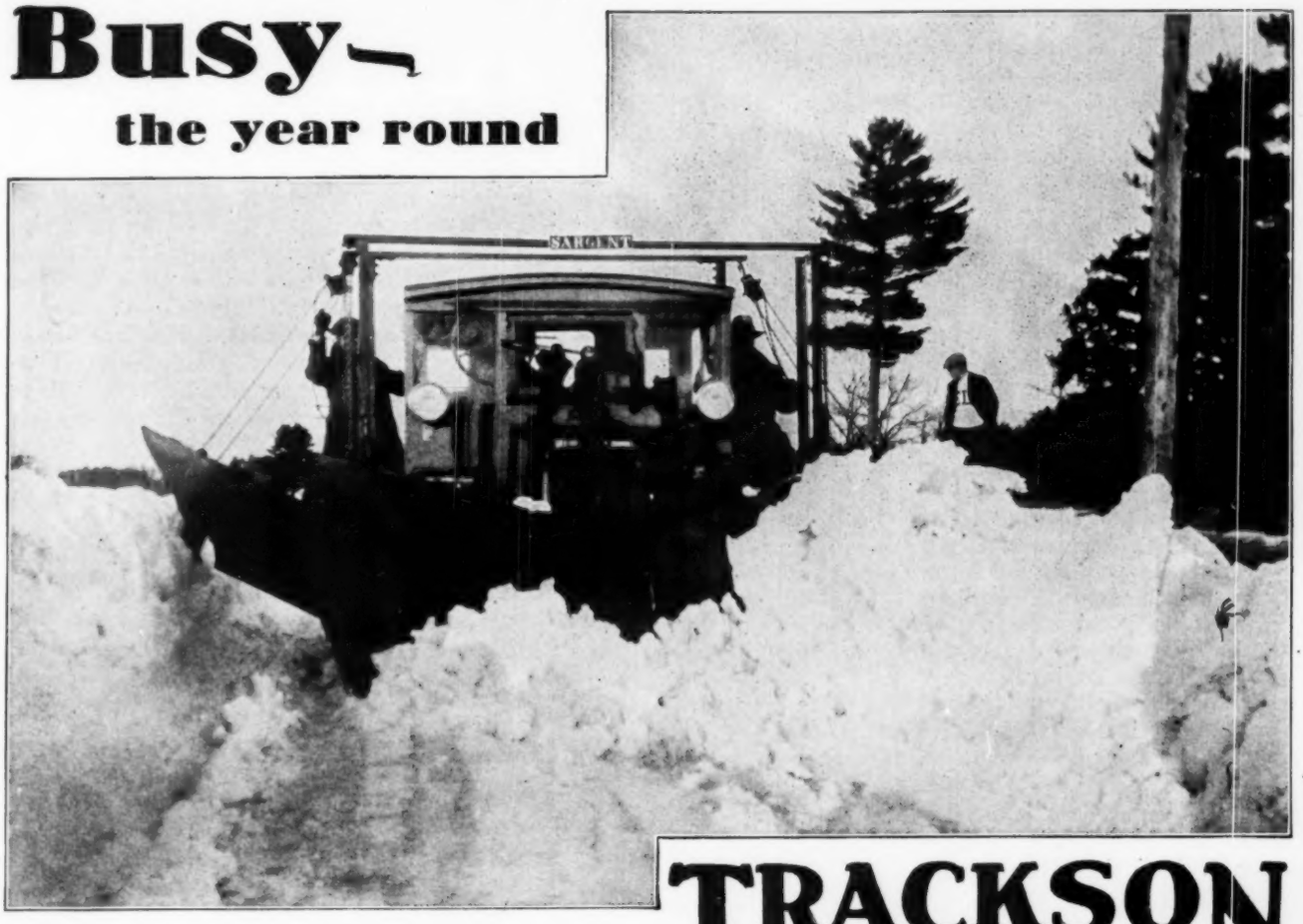
In explaining our snow problems it is first necessary to convey some idea of the topography of the country over which our roads extend and of the weather conditions that are encountered. In describing these features I shall confine myself to those of northwestern North Dakota because it is this territory with which I am well acquainted. However, they are fairly representative of conditions in other portions of the state.

About three-quarters of the area consists of gently rolling prairie with about one quarter hilly land. Portions of the prairie are cut by fairly deep river valleys of glacial origin with deep coulees running back from them to a distance of fifteen miles or so. It is almost treeless except along the water courses. In its primitive state it was the range of the buffalo herds and the summer hunting grounds of Indian tribes from the more sheltered country east and west. Such Indians as remained during the winter sought protection from the fierce winter storms in the timber along the Missouri River.

It can be said of the weather that winter temperatures are as low as in any portion of the United States. Winds are almost continuous and often of high velocity. Steffanson, who was reared in North Dakota, said, "If you live in North Dakota and are going on a polar expedition, all that is necessary is to take off a few clothes." The snowfall is moderate. Some winters we

Ten Ton Caterpillar and Wasau Displacement Plow in Operation

Busy—
the year round



TRACKSON
McCORMICK-DEERING

ROLLING back the heavy drifts with a big snowplow, or clearing the light falls with a grader blade . . . cleaning out ditches, or snaking wagons and trucks from a mud hole . . . purring along with a one-man grader, or back-filling tons of dirt in one mighty shove—it's all in the year's work for Trackson McCormick-Deerings. Snowplows, bulldozers, one-man graders, etc., are easily attached to and detached from these all-purpose crawler-tractors because of wide clearance between the tracks and motor. Low cost, dependability and year-round usefulness further make them just about the wisest investment any community can make. Write for folder 177.

MODEL LH

Trackson Company
CRAWLERS AND TRACTOR EQUIPMENT

1324 SO. FIRST ST. MILWAUKEE, WIS.

have almost none; a very few winters as high as three or four feet. However, the average amount that is on the ground at any one time is from six to eighteen inches. The scourging winter winds move whatever snow is on the ground for miles, drop it in the lee of hills, ridges, or whatever obstruction natural or unnatural that it may encounter, and there pound it into dense hard-packed drifts. A fall of a foot of snow will furnish the wind with sufficient material to cause blizzards for a period of six to eight weeks after it has fallen. Most of the land is under cultivation and many fields are fall plowed right up to the edge of the narrow sixty-six foot right of way of the highways. Such fields blow bare furnishing a great reservoir of snow which will move onto the road if obstructed in any way. It is apparent that our highway department is faced with a mighty serious problem when the public demands that the roads be kept open, a requirement that has not been made upon it until the last three or four years.

With its limited funds the department is responding in the following ways:

1. By location and design on all new grading to avoid snow traps and on the prairie to keep the grade-line high enough above the surrounding country to provide a windswept surface.
2. By placing slat snow fence along cuts on our older and lower roads.
3. By a small amount of snow removal equipment.

There are conditions under which all of these remedies have failed but the first is by far the soundest. Providing a right of way from two to four hundred feet wide to prevent plowing up to the roadside will no doubt be fostered when the general public has become educated to that point.

Our experience with snow removal equipment is limited to five units. The first which was used during the winter of 1927 is of the "V" plow type with rotors on each side. This type had been used with success in the more sheltered states to the east. However, when it encountered North Dakota winds its principle of throwing a portion of the snow against the wind did not produce the desired results. We are informed by the highest authority that "he who spitteth against the wind spitteth in his own face." Our first snow plow was in much the same position as the unfortunate person

Above—Truck Plow Followed by Rotary Successful

Upper Left—Snogo Cutting Ice Covered Drift

Left—Displacement Plows Alone Cause Huge Drifts

Lower Left—Cleaning Up Displacement Plow Ridges

of the proverb. In December, 1928, two speed plows mounted on four wheel drive trucks were furnished to the division. Conditions were almost ideal for their operation during that winter and they made a very good showing, each plow keeping open about a hundred miles of road that otherwise would have been blocked.

Two years ago a push plow was furnished for the 10-ton crawler tractor. The displacement plows soon proved themselves entirely inadequate to meet conditions as they were the winter of 1929 and 1930. Ridges pushed up by the plows filled in time and again until the snow for a great distance on each side of the road had been collected on it. It was very disheartening to view the great mass of snow collected on the roads and blocking them after so

much desperate work had been done attempting to keep them open. Operation of the displacement plows did more harm than good.

After the displacement plows had proven themselves inadequate to meet conditions we were furnished with a plow having horizontal augers for cutting down the snow and feeding into a fan which could discharge in either direction with the wind. This machine (which is rather a mechanical snow remover than a plow) did some very good work and met every requirement.

It would seem that the combination of the speed displacement plow to open up roads for traffic followed by the mechanical snow remover to cut down the ridges and throw the snow with the wind is the only method which can cope with North Dakota conditions with any consistent degree of success.

Two transcontinental railways operating east and west through the state have been able to keep their main lines open for the past twelve years by snow protection methods with the exception of about three days. Wide right of way together with protecting belts of trees and shrubs and much snow fence are used. When highway traffic over a given road becomes as important as that of a transcontinental railway we at least have an example of how the road can be kept open.

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Fargo Thaws Sewer Leads

Snow equipment for the City of Fargo, N. D., consists of one Holt "20," 2 patrol maintainers, one 3½-ton truck with a V-wing plow, one locally constructed combination V-plow and drag and three trucks for hauling snow. This equipment is supplemented after storms by hired equipment, teams with snow slips and labor.

We do not attempt to battle a storm ordinarily, but wait for it to subside. The truck plow is then sent out to open up arterial and commercial streets. The snow, except in the downtown section, is not removed, but is pushed to the curb and parking. Where sewers are 4 feet or over in diameter, the teams slip snow into the manholes. At other locations, it is loaded by hand into trucks and dumped in suitable places. Occasionally a period of alternate wet and cold gives an accumulation of ice and rutted snow. This is removed by the patrol graders which use the scarifiers to assist. Work is usually started at the curb and windrowed out to where it can be loaded or slipped. Our snowfall is not normally wet and heavy, but is dry and accompanied with winds which drift it. In residence sections, the home made V-drag (20 ft. across) is used to crowd the snow to the side and pack it.

Sidewalks are cared for by the property owner. The city starts crews of men equipped with shovels out after the storm, who remove snow from walks in front of vacant property first and then return and clear all walks which have not been cleaned by the resident. Cost of removal of snow from sidewalks by the city is assessed against the abutting property. Late in the winter and in the early spring, we have the problem of catch basin leads freezing up. Water flowing along the gutter trickles down the tile pipes which are in the frost zone and freezes. For this problem we have three stationary boilers of 10 hp. capacity, mounted on steel frames and running gear, fitted with water and coal tanks and truck hitch. With these units, each hauled by a truck and manned by three men, it is possible to steam out frozen leads in from five to ten minutes and in this manner facilitating the removal of water from the streets.

Fifteen Per Cent More Snow Raises Removal Cost 33 Per Cent

By HAROLD S. CROCKER
City Engineer, Brockton, Massachusetts

BROCKTON, MASS., is an industrial city with a population of a little more than 63,000 inhabitants. It is situated twenty miles south of Boston and fifteen miles west of the coast. The proximity of salt water lessens, of course, the amount of snowfall and also aids its disposal by melting. The mean temperature of the city for the winter months will not vary much from 30 deg. The average snowfall per year for the past forty years, the length of time there has been an observatory here, is 39 in. In a New England climate, however, one cannot expect weather to follow or even approach average conditions. In fact, the year's snowfall during the period of forty years referred to has varied from 10¼ in. to 76 in.

The city covers a comparatively large area for this section of the country. It contains 21½ square miles within its corporate limits. It has 141.45 miles of public thoroughfares. In addition to this mileage, during the season of snowfall there are over 30 miles more of private ways that are plowed.

Snow removal is a function of the highway department and is directed by Superintendent of Streets, Mr. Arthur J. Creeden. The work is done by city laborers and with city equipment, except that some trucks have to be hired from local contractors. Mr. Creeden divides the city into zones and assigns a foreman to take charge of each. Equipment and labor is assigned to each division.

The snow fighting equipment consists of two 5-ton tractors, two 2-ton tractors, two Wehr graders, two Barber-Greene snow loaders, 14 V-shaped plows attached to heavy trucks, one Walter Snow Fighter, and about 50 horse-drawn sidewalk plows.

The Walter Snow Fighter is used on the main highways and patrol. The trucks with the plows attached are used on all streets through the "in town" districts, and the tractors are used on the outlying districts. The Barber-Greene loaders are employed in the business district. They load into trucks and also into horse-drawn carts, which carry the snow to large drains, streams or other places suitable for dumping. The graders seem to be less efficient than either truck or tractor plows. The latter, of course, are so much slower than the trucks that their employment is confined to the outskirts.

Plowing starts when the depth of snow has reached 2 in. The work continues for the duration of the fall, and in most cases for several days after the storm has abated. An effort is made to clean the highways practically to their full widths in as short a time as possible. It is the desire of the superintendent to furnish a dry pavement for traffic, not only for the safety of the traveling public but also for the preservation of the roads. If vehicles are allowed to travel in ruts

in the snow, all the wear will come on a narrow strip of pavement, and since practically all will have chains on their wheels the road surface will receive tremendous punishment. It is our experience that drivers will remove chains as soon as possible, because very few enjoy driving with them unless they are absolutely necessary for safety.

Encourage them!

Most of the through thoroughfares to surrounding towns are state highways in the outskirts of the city. Snow removal there is, of course, a function of the State Department of Public Works. That department uses fences to prevent drifting. There are no localities within the city's jurisdiction where it has seemed advisable to set up fences.

All sidewalks are plowed sufficiently so that pedestrians may use them with reasonable safety. If the walks are not cleared entirely of snow and slush and a lowering temperature changes the latter to ice, sanding crews are sent out to sprinkle sand on the slippery sidewalks. Wherever there is a considerable grade, streets are sanded for a distance of 50 to 100 ft. back from an intersection with another highway. This work is done, in most places, with a sanding machine. The sand is, of course, of great assistance to the driver who has to slow down or stop at the intersection. Incidentally, it is a safety device for children who will coast on these grades when the police are not in sight.

A special crew of men are sent throughout the city to clean snow away from catchbasins, so that they may function properly when melting begins.

During the past winter there were five storms that deposited snow to a greater depth than 2 in. December 23rd produced 3 in. and four days later 4½ in. more were added. The last day in January saw a fall of 7½ in. and on February 20th 4 in. fell. The largest single storm of the year was on March 4th and 5th, and amounted to 11½ in. The total snowfall for the year amounted to 35 in.

The direct cost of snow handling during the past winter is as follows:

Labor	$11,408.32
Trucks and teams	2,179.90
Graders and loaders	726.12
	$14,314.34

The sanding operation costs are divided thus:

Labor	$4,381.96
Trucks and teams	1,411.00
Sand	546.35
	$6,339.31

A total direct charge payable from this year's budget of $20,653.65.

Snow removal and sanding costs in the previous year, for a fall of 30 in., was $15,368.97. Fifteen per cent more snow the past winter than in 1929-30 cost the city 33 per cent more expenditure due, in part, to the fact that during the last winter snow came at fewer intervals but in larger quantities.

The above figures are somewhat misleading because the local highway department does not go into accounting accurately. There is no charge included for supervision. "Teams" and "trucks," however, are charged from another account and include overhead charges. "Graders, loaders, etc.," are only direct charges and do not include any overhead. The figures do, however, show very approximately how snowfall affects the tax rate.

The 1931 tax rate is 27 ct. per $1,000 higher than it would have been had this work we have under consideration been omitted.

It is my wish that an accurate figure, including all overhead charges, might be available; but if it were, it would mean little to anyone outside of a very restricted area adjacent to this city.

The character of snow varies greatly as to density, with the resulting variance in ease of handling. Wind directions and velocities increase or diminish one's trouble. Temperatures above freezing during or after a storm mean rapid melting of snow, so that even with a 2-in. fall it might be unnecessary to send out equipment. These factors, particularly together with other problems peculiar to a locality, make comparative cost figures per inch-mile of little value. Right here in this city, with the same equipment, same personnel, and the same efficiency, the inch-mile cost of snow removal and sanding this year increased 45c to $3.47, as compared with the previous winter, with only a very small increase in snowfall.

It is the writer's belief that the snow handling is done efficiently in this city, and to the satisfaction of the citizens who do not object to the expenditure of money for snow removal, but applaud its rapid disappearance.

▼

Unemployment Relief

Keeping streets free from snow at Grand Forks, N. D. Many cities keep thousands of hand shovels in the stock room in readiness to clear up streets after a snow storm. Tractors may be used in all seasons on road and street work

Colorado

Clearing Blocked Highways in the Uplands and Passes Becomes Real Maintenance Problem

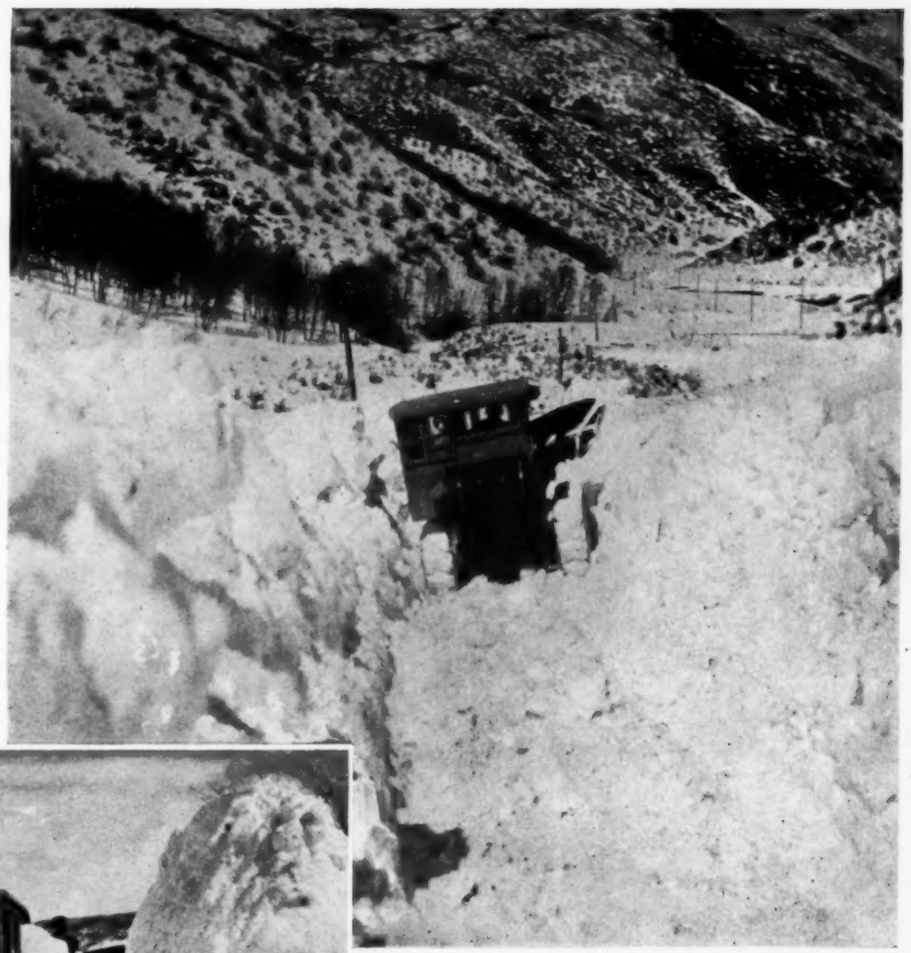
All but Buried This Sargent Wing Plow Pushed by a Cletrac Slowly Noses Through Deep Drifts

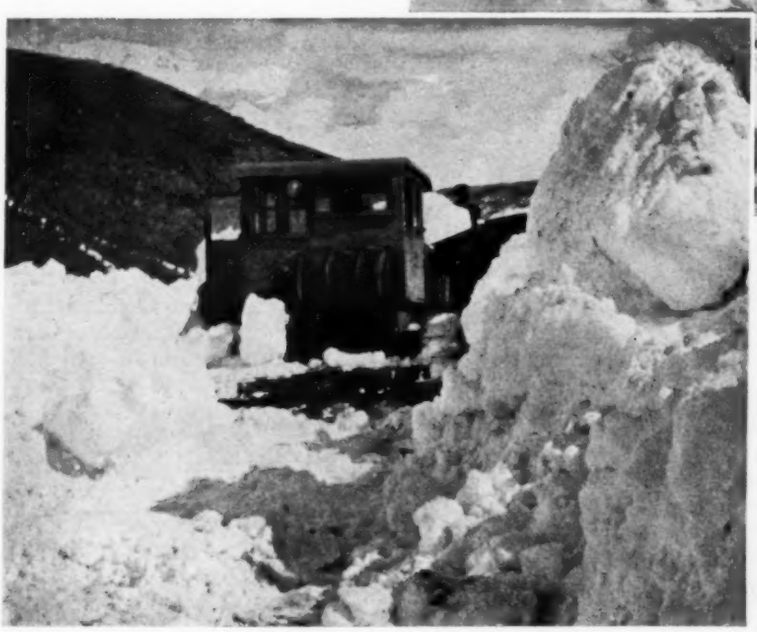
So Deep Do the Drifts Form That More Than One Trip Is Necessary to Open a Path. First Time Through the Wings Are Folded Back. On Succeeding Trips They Shove the Top Layers Clear

Shoving Along in Moderate Going as the Sun Slowly Sinks, This Tired Crew Will Soon be Replaced by a Night Gang

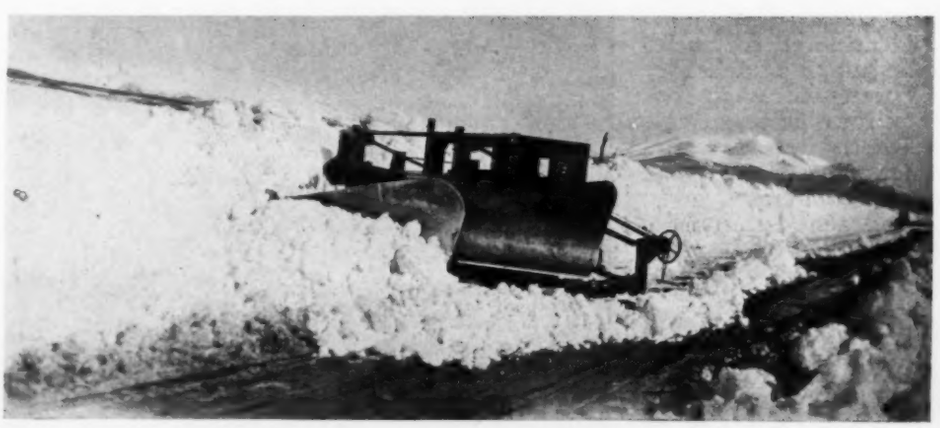
Digs Out

Highway No. 13 Between Mt. Streeter and Meeker, Colorado, Held Up All Traffic Until This Monarch Tractor Pushing a Displacement Plow Opened the Way





At Times the Crew Was Beset With Packed Drifts That Took Hours of Constant Attack Before the Path Was Cleared. Unlimited Patience, Dogged Persistence and Warm Clothing Would Finally Win the Fight



Here We Have a Monarch 75 Shoving a Ridge Off the Shoulder of the Road Before the Thaw Can Spoil the Surface

Distributor News

Industry Takes Active Part in Relief Work

Plans are under way in all parts of the country to perfect citizens' organizations to relieve the winter's unemployment situation. Remarkable readiness to co-operate on the part of all leaders of industry as well as all working employees is evident on every hand.

In line with this common duty in times of stress, Mr. Edward L. Ryerson, Jr., president of Joseph T. Ryerson & Son, Inc. has accepted President Hoover's invitation to become one of a committee of 60 leaders in business, economic, and

Edward L. Ryerson, Jr.

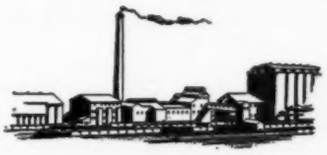
sociologival activities to assist Walter S. Gifford, president of the American Telephone & Telegraph Co., as director general of the nation's relief program. Fred C. Croxton of Columbus, O., who has been acting chairman of the President's committee since the resignation of Col. Arthur Woods, New York, will be assistant director.

Mr. Edward L. Ryerson, Jr., is also chairman of the Governor's Commission on Unemployment and Relief for the state of Illinois.

▾

Southeastern District Sales Office Opened by Page Steel & Wire Co.

The Page Steel and Wire Co. is opening a southeastern district sales office with headquarters at 1520 Healey Building, Atlanta, Ga. This new office will be in charge of R. J. Teeple, who will have charge of distribution of all Page Products in the southeastern district. These products will include various types of woven wire fence, wrought iron fence,



welding wire, highway guard and general wire products.

Mr. Teeple has been connected with the Fence Department of the Page Steel and Wire Co. for the past ten years, and has been in charge of the Chain Link Fence Division for the past three years.

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"Caterpillar" Enters Stationary Engine Field

G. M. Walker was appointed advertising manager of the Caterpillar Tractor Co., and Walter H. Gardner, formerly Advertising Manager, was made Manager of the Specialty Sales Division.

This newly formed division is created primarily to market "Caterpillar" engines and sub-assemblies to other manufacturers. The full line of "Caterpillar" engines, both gas and Diesel, will eventually be adapted for the use of equipment manufacturers generally.

This division will also direct the company's present activities in promoting sales to railroads and public utilities.

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Announcement

The Birmingham Office of the Independent Pneumatic Tool Company has moved from the Comer Building to 915 North Seventh Avenue. The new location has warehouse facilities which will enable the Birmingham office to carry a complete line of pneumatic and electric tools, as well as spare parts. H. F. Halbert is manager.

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Effective October 1, the central district office of the Massey Concrete Products Corporation was transferred from Dixie Terminal Building, Cincinnati, Ohio, to 908 Midland Bank Building, Cleveland, Ohio. W. Lyle McDaniel is Resident Manager of this district.

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Canton Secures Large Culvert Contract

A contract for corrugated galvanized metal culverts amounting to more than $500,000 was recently awarded to the Canton Culvert Co., Canton, O., by the Division of Highways of the State of Pennsylvania. This order is said to represent the largest single contract ever placed for culverts of this type. It calls for approximately 700,000 lin. ft. of culverts, totaling 130 miles end to end, in diameters from 12 to 48 in. The Canton Culvert Co. has manufactured culverts since 1908, specializing in the use of Toncan copper molybdenum iron corrugated galvanized sheets produced by Republic Steel Corporation.

D. C. Babcock, Branch Sales Manager F. W. D., Dies at Wausau, Wis.

Dean C. Babcock, Branch Sales Manager of the Four Wheel Drive Auto Co. died Sept. 1. at Wausau, Wis.

Dean C. Babcock was born at Kaukauna, Wis., Oct. 30, 1896. His parents later moved to Wisconsin Rapids, where he was graduated from the high school, after which he attended Carroll College at Waukesha.

After graduating from Carroll, he entered the employ of the Nekoosa-Edwards

Dean C. Babcock

Paper Co. as a member of their chemical staff, where he remained for three years. In March, 1920, he joined the F. W. D. organization as a member of the sales department. His earnestness and ability won him the confidence of the management and his promotion was only a matter of time. In January, 1926, he became branch manager in charge of all factory branches.

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Jack Conway Made Sales Manager of the H. O. Penn Machinery Co.

H. O. Penn Machinery Co., 140th St. and East River, New York City, N. Y., announces the appointment of Jack Conway as sales manager. Mr. Conway, in the construction equipment field, has acted as sales manager for the Complete Machinery Co. of New York City, Hunter Machinery Co. of Pittsburgh, and the Leach Mixer Co.

Service Exchange
for Manufacturers or Distributors

Editor's Note.—From time to time we receive letters from distributors wishing to be put in touch with manufacturers of certain lines of equipment, or from manufacturers seeking representatives of their products. Items of this kind will be published and names and addresses furnished interested persons upon request.

New Lines Wanted

Distributor covering northern Illinois and southern Wisconsin desires additional lines, especially compressors, form graders and proportioning scales for mixers.

University man, now selling foundry and sheet metal field in Northwest, desires additional accounts on commission basis only. Will travel to factory at own expense and spend necessary time to familiarize himself with line.

Newly organized distributing company located in Boston, desires to secure a few road machinery accounts for New England territory.

Distributing organization located in Tennessee desires to handle a complete line of road building equipment.

Manufacturers' representative, clientele, state of New Jersey. Can represent manufacturers or contractors machinery, accessories, materials for general contractors and stone crushers. Large or small units.

Man experienced in building construction field desires position with construction or engineering firm. Familiar with credit and estimating—also has had some selling experience. Permanent position is desired and location is immaterial.

Civil Engineer, located in California, desires to represent manufacturers of equipment and supplies. Is widely acquainted in western states and can furnish engineering and financial references.

Services of experienced engineer available. Formerly connected with state highway department, and well known manufacturers. Will consider proposition from manufacturer or distributor of highway construction equipment.

Warehouse facilities for serving Pittsburgh territory. Would like to secure line of portable and stationary conveyors.

Distributor covering Wisconsin and Illinois territory wishes to add to present lines. Thoroughly familiar with bituminous materials and equipment for handling.

Distributor situated in Portland, Oregon, desires line of stationary diesel engines, from 75 to 150 hp., to serve western trade for driving rock crushers and industrial plants.

Manufacturer's representative with 25 years' sales experience, conversant with all types of pumps and their field, desires agency for either New York or export territory or both.

Sales engineer, experienced in earthmoving machinery, desires connection on salary or salary and commission basis. Wide acquaintance with machinery dealers, oil and gas industry, pipeline contractors and material men. References.

Manufacturer's representative situated in New York City, now handling pumping machinery, would like to take on two or three additional lines serving the same field as his present account.

Distributor situated in Virginia wishes to make connection to represent manufacturer of manganese crushing plates and jaw rock crushers.

Wanted, line of picks, sledges and crow bars, spades, shovels and similar implements by New Jersey broker, with warehouse facilities, contacting New York and New Jersey jobbers.

Distributor of building specialties covering territory within 100 mile radius from Chicago is equipped to represent additional lines.

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Representatives Wanted

Manufacturer of vapor spray cleaning device used by contractors for cleaning construction equipment and also for removal of dirt, grease, etc., from the surface of stone and brick structures, wishes to secure sales agents in the larger cities.

Local dealer or salesman wanted—who is personally acquainted with his city or town officials. Can earn liberal commissions selling street signs. Used in over 350 leading cities.

Textile manufacturer wishes sales representative to handle complete line of tarpaulins. Distributors, now handling road building equipment and other contractors' supplies, especially desired.

Manufacturer of crushing and screening plants wants a representative in Manila, Philippine Islands.

Manufacturer of grader wants dealers in west and east central states.

Manufacturer of a new tractor dump wagon has a number of desirable territories open. Full cooperation extended to distributors.

Manufacturers of ditching and trenching machines, to facilitate the laying of pipe lines has liberal proposition to offer dealers.

Manufacturer of metal traffic lane markers for pavements, has a number of desirable territories open. Write for their proposition.

Manufacturer of patented highway and zone marking machine desires sales representatives who are acquainted with highway officials in their own state.

Manufacturer of complete line street repair equipment, tar kettles, heaters, patching plants, torches, etc., has open territory in southeastern states and desires active distribution. Territory largely open from Virginia to gulf states, inclusive, also state of Oklahoma.

Distributor with large warehouse, show room and service facilities, desires two or three additional lines. Maintains large sales organization, covering New York, Vermont, Maine, Massachusetts and Connecticut.

Manufacturer of asphalt ingredient adaptable for use in the road or industrial field, is seeking representatives for desirable territory in various parts of the country.

California territory available for distributor wishing paving expansion joint account.

Manufacturer of transverse testing machines desires to build up distribution organization in this country and abroad.

Several desirable states open. Wanted, distributing organizations covering entire states by manufacturer of mechanical spreader.

Territory open in several states for representatives to handle grade-rippers, mechanical plows.

Manufacturer of steel dump bodies and oil heaters seeking distribution points in west central and southern states, including Missouri, Kansas, Iowa, Nebraska, Colorado, Kentucky, Tennessee, Mississippi, Arkansas, Louisiana and western half of Illinois.

Attractive territory open in states south and west of Chicago by manufacturer of cut-to-length, easily-erected standardized steel highway bridges, for spans up to and including 40 ft. Product sells to highway commissioners and superintendents.

Manufacturer of metal tie and spacer wishes to establish distributing points throughout the country.

Manufacturer of contractors and builders levels and transits is seeking district sales manager. Exclusive contract given. Excellent territory still available. Backed by national advertising.

Manufacturer of complete line of construction equipment, mixers, saw rigs, plaster and mortar mixers and pumps has an open territory in the state of Maine and is looking for an aggressive distributor to represent him there.

Manufacturer of patented luminous highway danger signs and signals is interested in securing aggressive representation in various parts of this country and Canada.

One of the leading manufacturers of surveying instruments in the United States is seeking responsible agents in all sections of the country. Instruments are nationally advertised in all leading engineering journals.

Eastern manufacturer of grade-rippers, scrapers and road hones has desirable territory open for distributors.